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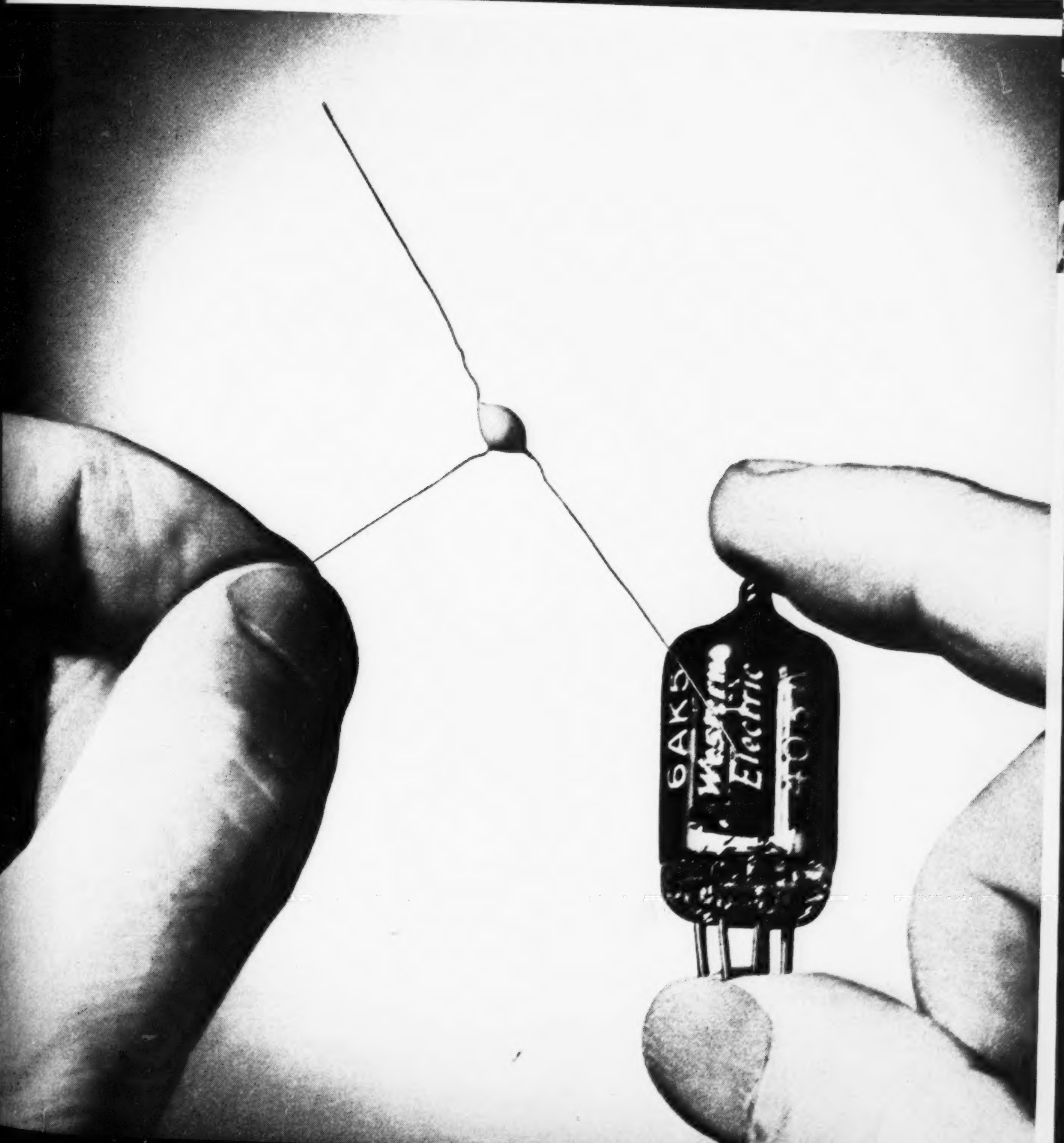

THE COVER: The 6AK5 vacuum tube and the Junction Transistor. See page 379.

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CONTENTS OF THIS ISSUE

Technical Section

News Section

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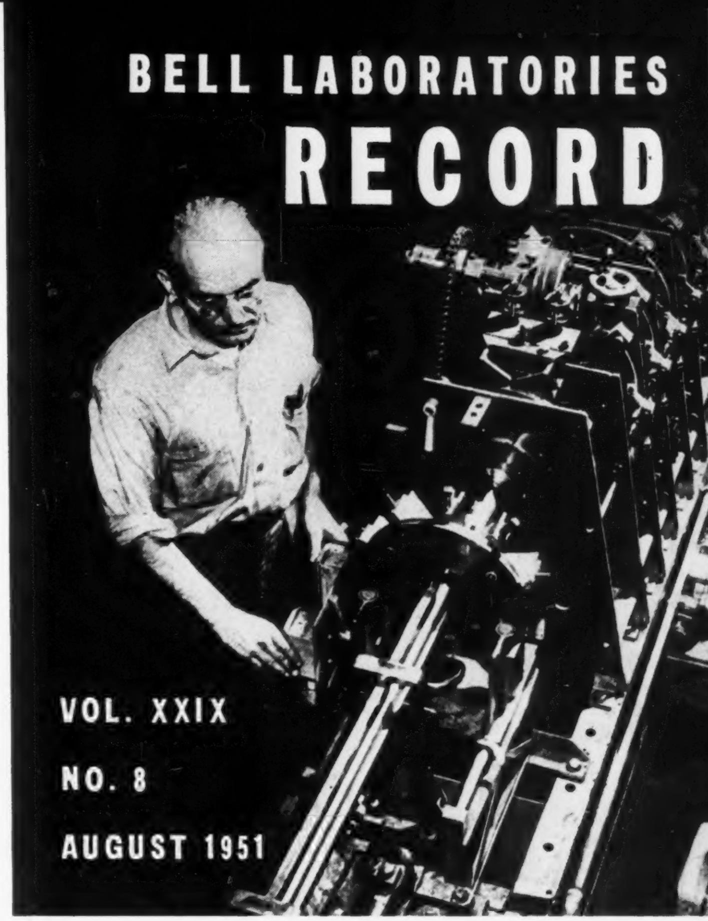
Stalpeth cable sheath

R. P. ASHBAUGH
Cable Design Engineer

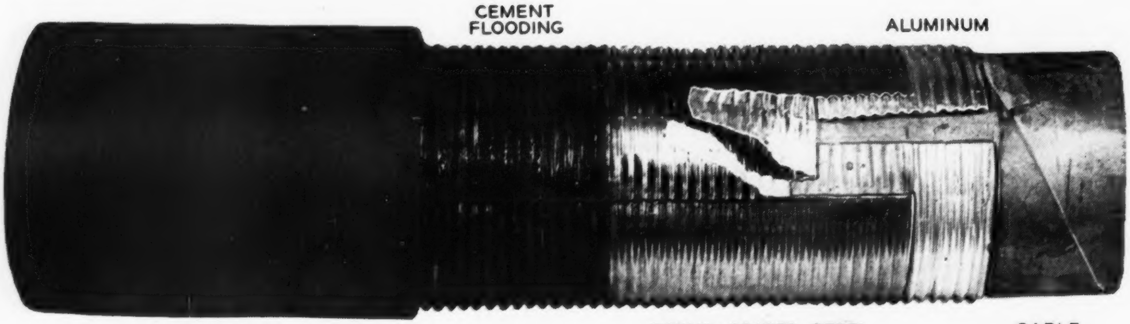


Developed by Western Electric cable engineers at the Kearny Works, this machine is an important step in the production of the new Stalpeth cable. The machine receives separate strips of corrugated steel and aluminum and forms them into overcoats around the cable core.

Alpeth cable sheath, first used in September, 1947, was conceived and put in production as an emergency design to allow large production of cable at a time when lead was in short supply and time would not allow waiting for the development of the triple barrier "brass" sheath which was then considered the ultimate objective. Since its introduction, approximately 25 percent of the exchange area cables have been manufactured with Alpeth sheath.

By and large Alpeth sheath has given a satisfactory account of itself. It has made possible the production of many more thousands of miles of exchange cable than could have been made available had it been necessary to depend upon lead alloy sheath alone. At the time of its introduction, Alpeth was a promising but untried structure, recognized as having many desirable features and two known shortcomings. The first of these latter was the uncertainty as to whether moisture might slowly diffuse through the polyethylene and the cemented seam in the corrugated aluminum to cause eventual deterioration in the insulation resistance of the paper covered wires in the cable core; the second, was the use of splice covering techniques more complicated and more costly than those required for lead covered cables. Thus, although Alpeth was considered and has proved to be an acceptable interim design, development was continued to bring about a metal-plastic sheath that would include a positive seal against moisture diffusion and would permit the use of simpler splice covering procedures.

Several types of sheath structure were considered in the course of the further development work. One of these, the brass sheath mentioned earlier, provided a layer of plated corrugated brass with a soldered longitudinal seam over the basic Alpeth structure. Another consisted of a "sandwich," with an inner belt of extruded polyethylene underlying the aluminum and polyethylene layers of an Alpeth sheath. Soldering or welding the aluminum in any of the metal-plastic sheath designs would provide a positive seal against moisture diffusion, and the possibilities of such construction were also explored. For technical or economic reasons none of these was found to provide the best solution of the



In Stalpeth, a layer of terne plated steel is applied over the aluminum, and the seam is soldered.

The author examining the soldered seam.

problem. A structure that may be thought of as an outgrowth of Alpeth was then developed.

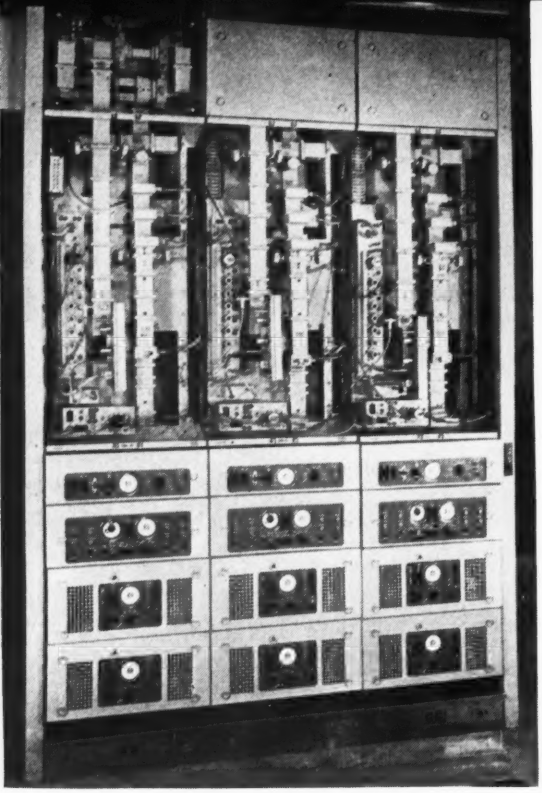
This consists of adding to the basic Alpeth design a terne plated steel envelope, corrugated and formed so as to mesh intimately with the aluminum, and to be applied over it in a single manufacturing operation. The steel envelope is overlapped, and the seam is readily soldered by a novel process in which a thin flat ribbon of solder is inserted in the overlap of the corrugated metal and inductive heating is employed to complete the seal. The rubber cement flooding is retained as in Alpeth. Because of the essentially complete sealing (it is improbable that a continuous seam could ever be guaranteed to be 100 percent perfect) of

A cable engineer at Kearny checks the new soldering process designed by Western Electric for the production of the Stalpeth cable. As the cable glides along the production line at the rate of 50 feet a minute, a quarter-inch strip of solder comes off the reel above, is inserted in overlaps of steel sheath and heated electronically, sealing the edges together.

the cable core against the entrance of moisture, the polyethylene jacket can be reduced in thickness approximately 20 percent, and the cost of the cable is essentially the same as that of Alpeth. A modification is that the aluminum envelope is made narrower than in Alpeth and is applied so as to leave a slight gap to avoid interference with the overlap in the terne plated steel. This sheath can be spliced much more economically than the Alpeth because a lead sleeve can be wiped to the terne plated steel in essentially the regulation way, and thus many of the extra operations required in the Alpeth sheath closure can be avoided.

This sheath has been named Stalpeth–*st* from steel–*al* from aluminum and *peth* from polyethylene. Preparations are going forward to change the entire output of Alpeth cable in the sizes larger than .88-in. core diameter to the Stalpeth design. One production line is operating at Kearny, and complete changeover at both Kearny and Hawthorne is expected some time this year.

THE AUTHOR: R. P. Ashbaugh graduated in Electrical Engineering from Ohio University in in 1910 and joined the Laboratories in 1911. Two years later he entered the lead-covered cable development group and has been in that work continuously since. He went to Japan in 1922 to supervise the placing and splicing of the first toll cable installed in that country and remained to work with the engineers of the Sumitomo Cable Works on problems of toll cable design. He returned to the United States in 1924 and was located at the Hawthorne Works of the Western Electric Company until 1938, and since then until his retirement at the end of May, 1951, was in charge of development work on exchange area cables at their Kearny Works. In 1943 Mr. Ashbaugh was appointed Cable Design Engineer. During this entire period he has been mostly concerned with development problems and he has been actively connected with many of the refinements in quadded cable design as well as the developments on fine wire cables, such as pulp insulation and unit type cables.



Three transmitter-receiver bays as used at a terminal or main repeater station.

Repeaters for the TD-2 radio relay system

G. R. FRANTZ, *Transmission Development*

Already in commercial service between New York and Omaha, the TD-2 microwave radio system* is scheduled to reach San Francisco late this year. When its facilities are fully utilized, it will provide six broadband channels in each direction, each capable of carrying a television picture or several hundred telephone conversations.

*Record, *October*, 1950, *page* 442.

Repeaters consist of a transmitter and receiver mounted on a single nine-foot bay called the transmitter-receiver bay, which is used not only at repeater stations but at terminals as well. At repeater stations each two-way broadband channel requires two such bays—one to receive, amplify, and transmit in each direction. At terminals, on the other hand, only one bay is required for each two-way channel, since

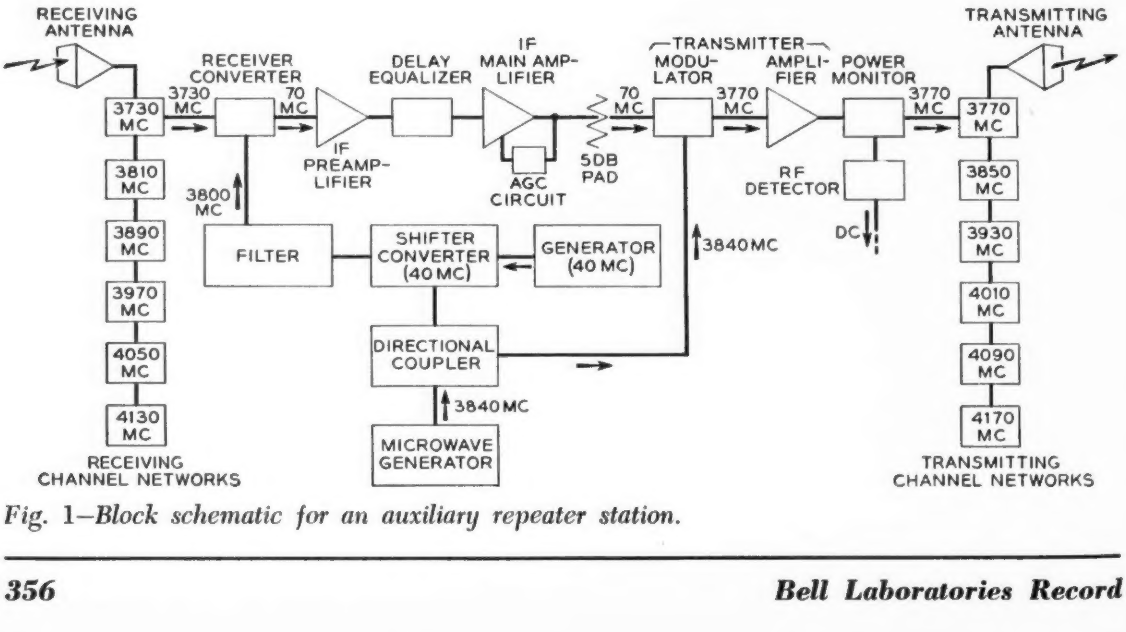


Fig. 1—Block schematic for an auxiliary repeater station.

through transmission is not required. There are differences in the connections to the bay at terminals and repeater stations, and at auxiliary repeater stations one panel of the bay is replaced because of a different method of deriving the receiver beating frequency, but otherwise the same bay is used throughout the system.

The receiver accepts signals in a band of frequencies in the range from 3700 to 4200 megacycles from an antenna, converts them to the intermediate-frequency band centered at 70 mc, and then amplifies them. The transmitter accepts signals at 70 mc, converts them up into the 4000-mc range, amplifies them, and then passes them to the transmitting antenna through a wave guide branching network.

A partial block schematic for an auxiliary repeater station is given in Figure 1. The other channels have the same frequency pattern except that for the four higher channels the beating frequencies are below the signal frequencies rather than above as for the first two channels. This is done so that no frequency outside the TD-2 band can interact with the beating frequency to give an IF near enough to 70 mc to interfere with the desired signals.

The microwave signals of the six channels are separated at the receiving end and re-combined following the transmitter by wave guide filter networks,* which makes possible the use of only two antennas for each direction of transmission. Although the FM signal sidebands extend over the major portion of the band, only the center frequency will be considered in the following discussion. In Figure 1, the channel 1 received frequency is 3730 mc. This is combined in the receiver converter with a frequency of 3800 mc, producing a beat frequency of 70 mc. This signal is amplified by the IF pre-amplifier and IF main amplifier, and is maintained constant by an automatic gain-control circuit. In the transmitter modulator, the 70-mc signal is combined with a frequency of 3840 mc, and the lower sideband, centered at 3770 mc, is selected by filters. It is then amplified by the transmitter amplifier to an output power level of about half a watt, and transmitted through the power monitor and the channel network to the transmitting antenna. The power monitor transmits a small portion of the output power to a detector where it is rectified to operate a sensitrol relay, which is tied into the alarm system so that a drop in output power sends an alarm to the alarm center. The alarm system will be described in a subsequent article.

The normal gain of a repeater is 63 db, with a maximum available gain of 85 db or more to take care of transmission variations. Over a band of 20 mc, the transmission of each repeater is flat to within 0.1 db, and the envelope delay is equalized to within 2 milli-microseconds by delay equalizers inserted between the pre-amplifier and the IF main amplifier. Typical amplitude and delay characteristics of a repeater without delay equalization are shown in Figure 2.

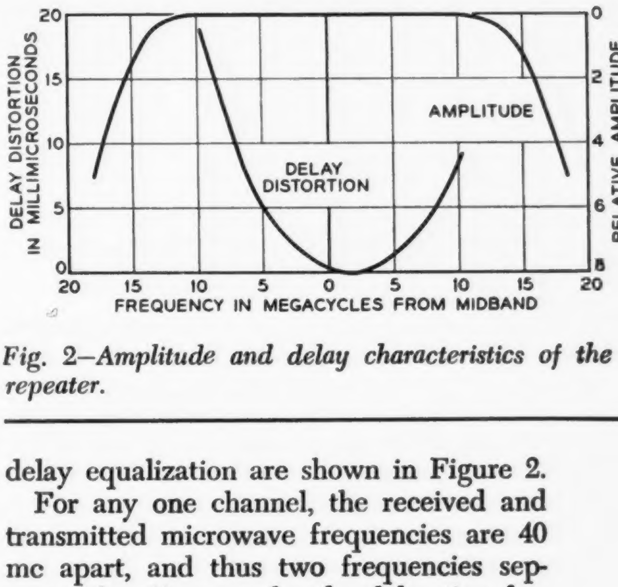


Fig. 2—Amplitude and delay characteristics of the repeater.

For any one channel, the received and transmitted microwave frequencies are 40 mc apart, and thus two frequencies separated by 40 mc—a low-level beating frequency for the receiver, and a high-level modulator frequency for the transmitter—are required for each transmitter-receiver bay. At terminals and main repeater stations they are provided by two microwave generators. These are very stable crystal oscillators operating in the range from 17.5 to 19.0 mc, and are followed by several frequency multiplier stages with a total multiplication factor of 216. The crystals are temperature controlled, and maintain their frequency to within about 40 cycles.

* Record, *September*, 1948, *page* 372.

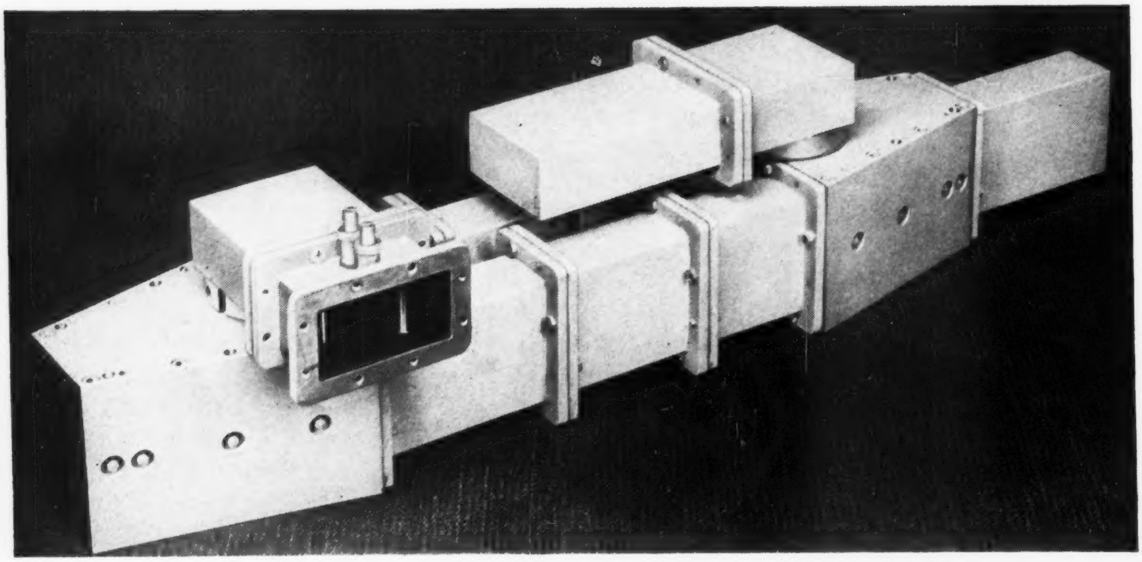


Fig. 3—Two wave guide filter networks, like that shown above, are mounted at the top of the transmitter-receiver bay and coupled to similar units on adjacent bays or to wave guide to the antenna as indicated at the right and left of Figure 1.

Three doubler and three tripler stages are used in the generator for the transmitter, but since less carrier power is required for the receiver, only five multiplier stages are employed—one a sextupler. This permits the same increase in frequency with one less stage.

At auxiliary repeater stations, on the other hand, only one microwave generator is provided, and temperature control is not used for the crystal. The output of this microwave generator is used directly as the modulator frequency for the transmitter, while to obtain the beating frequency for the receiver, the output of the microwave generator is modulated with the output of a 40-mc oscillator. This arrangement provides the 40-mc shift between the received and transmitted frequencies, and also makes the transmitted frequency independent of the frequency of the microwave generator, since any error in the generator frequency cancels out. An error of +1 mc in the microwave generator, for example, would re-

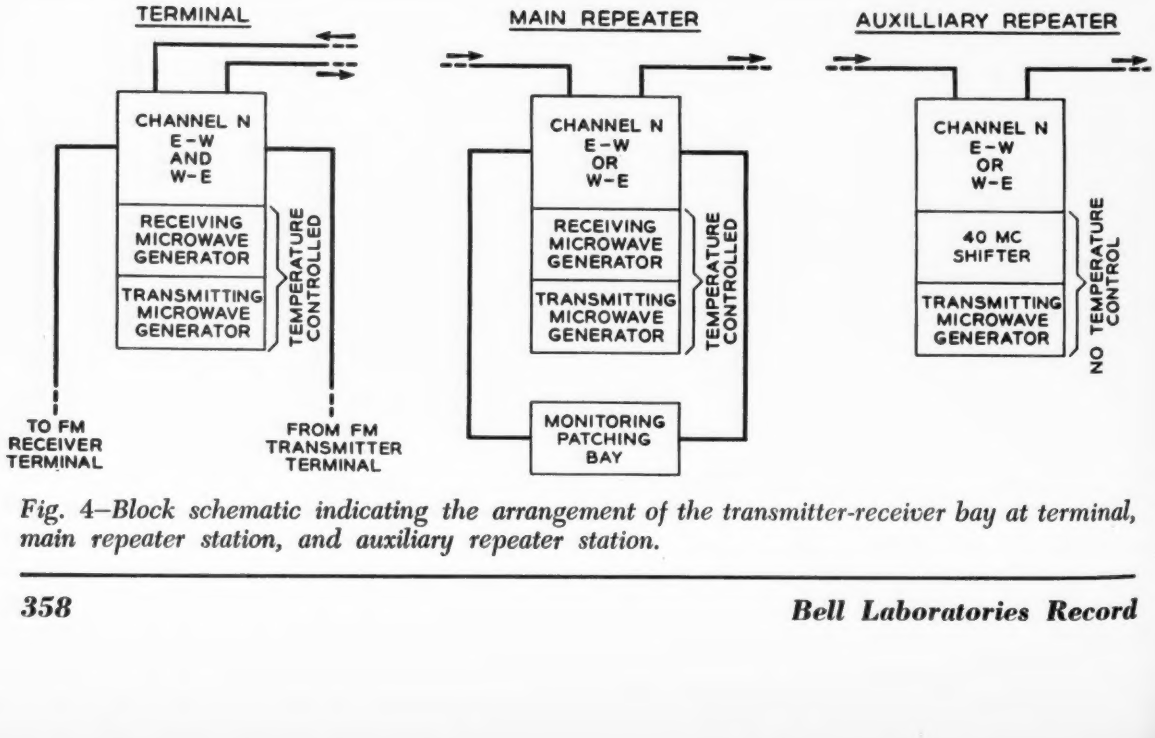


Fig. 4—Block schematic indicating the arrangement of the transmitter-receiver bay at terminal, main repeater station, and auxiliary repeater station.

sult in a modulator frequency of 3841 mc for the channel illustrated in Figure 1. The beating frequency for the receiver would be 40 mc less than this, or 3801 mc. The beating of the received frequency of 3730 mc with this latter frequency would give an IF of 71 mc. In the transmitter modulator, however, this IF of 71 mc with the modulator frequency of 3841 mc would result in an output frequency of 3770 mc, which is the correct value in spite of the error of 1 mc in the microwave generator.

The locations of the various units on the transmitter-receiver bay may be seen in the photograph on the first page of this article. At the top are the wave guide coupling units through which the bay is connected to the incoming and transmitting antennas. One of these units is shown in detail in Figure 3. Within the large compartment occupying most of the upper section of the bay is the equipment indicated along the upper line of Figure 1, while in the lower part of the bay are the transmitter and receiver control units and the two microwave generators. At an auxiliary repeater, the receiver microwave generator would be replaced by the 40-mc oscillator and the shifter converter as already mentioned. The differences in the connections to and the arrangement of the bay at the three types of stations are indicated in Figure 4.

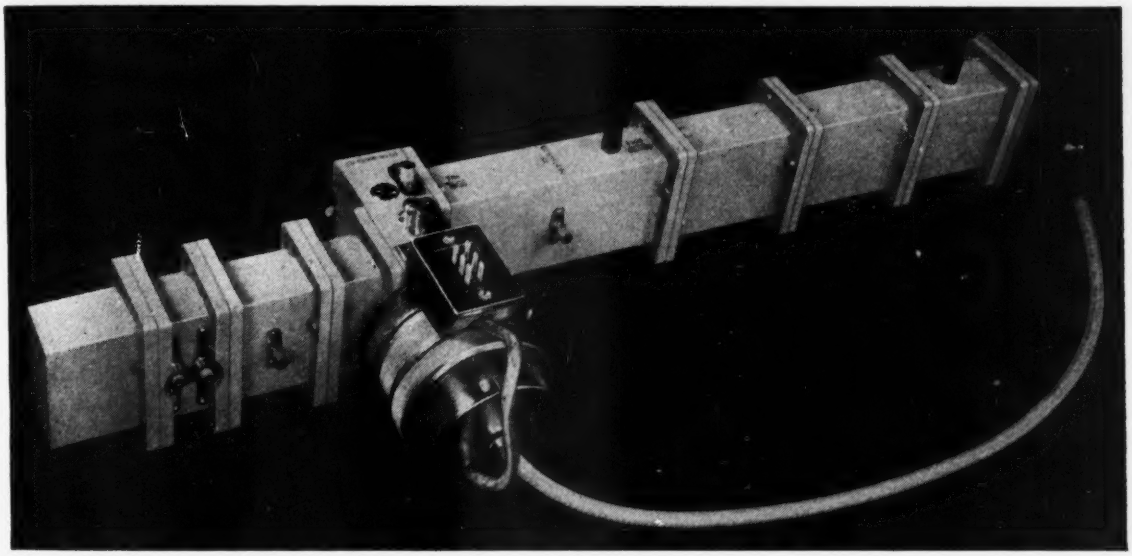


Fig. 5—The transmitter modulator.

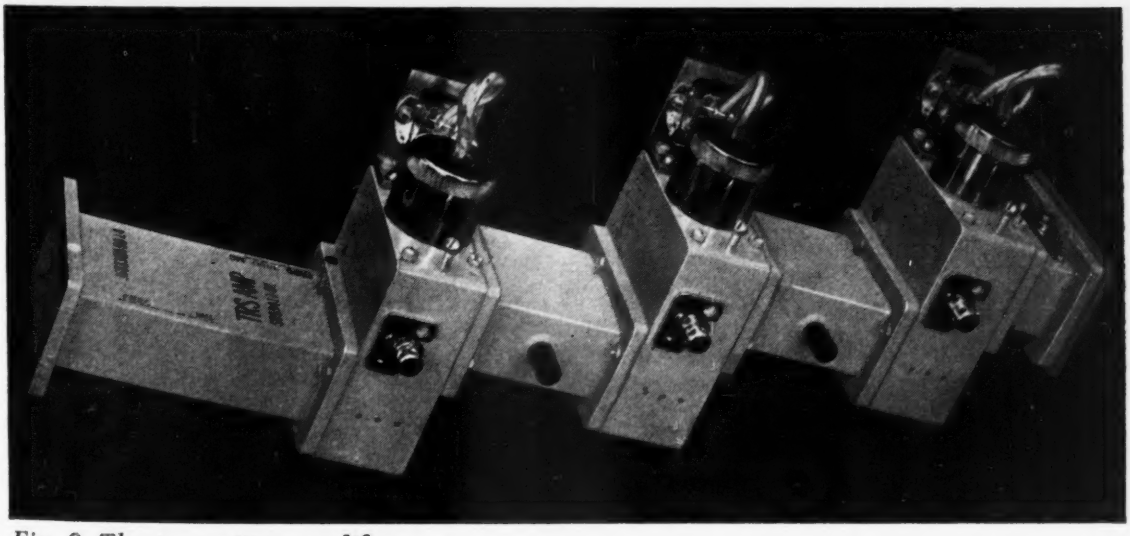


Fig. 6—The transmitter amplifier.

The converter-preamplifier assembly consists of a balanced silicon varistor converter followed by two 417A grounded grid triodes in tandem. The gain of this assembly is about 4 db.

The IF main amplifier consists of eight amplifier stages providing a normal gain of about 40 db with a maximum available gain of about 65 db. The first stage is a grounded grid 417A triode and is followed by six 404A pentodes* and a final 418A tetrode. Automatic gain control is provided by rectifying a portion of the output power to obtain a feedback bias voltage, which operates on the second through the sixth stages to vary the gain as required to maintain constant output.

A close-up of the transmitter modulator with its associated wave guide filters is shown in Figure 5. It uses a 416A† grounded grid triode mounted in a cavity with input and output tuning. A high level signal from the microwave generator and a moderate level intermediate frequency signal are both impressed on the cathode of the tube. The desired microwave signal at the output is selected by the wave guide filters. The modulator has a conversion gain of about 8 db.

The transmitter-amplifier, shown in Figure 6, consists of three grounded grid 416A triodes mounted in cavities like that of the transmitter modulator. Each stage is preceded by an impedance matching tuner, and the final stage is followed by a filter section that flattens the band and improves the output impedance match. A gain of from 16 to 22 db is obtained by adjusting the cathode bias on the first stage.

The transmitter-receiver bay is maintained using special test equipment provided at each station. Spare units are stocked, and can be used to substitute for components which require repairs or complete alignment. Such repairs are made at maintenance centers where additional test facilities are available. The testing and test equipment will be covered in a forthcoming issue of the Record.

* Record, February, 1949, *page* 59.

† Record, *May*, 1949, *page* 166.

THE AUTHOR: After receiving a B.S. in E.E. in 1935 and M.S. in E.E. in 1936, both from the University of Colorado, G. R. Frantz came to New York to join the Laboratories. His first assignment was in the design of laboratory testing equipment for measuring coaxial system components. Then he studied phase measurements for the equalization of coaxial and television circuits. During World War II, Mr. Frantz worked on waveguide test equipment and airborne radar equipment. Currently he is engaged in the design of microwave transmission systems.

Sound for an assembly room

L. B. COOKE
Systems Engineering

Need for a large general purpose auditorium in the Bell System headquarters building at 195 Broadway, for lectures, conferences, and a wide variety of employee activities, and for stockholders' meetings, led to an extensive program of remodeling of the existing third floor assembly room. Although limited in the amount of floor area that could be used, it has been possible to obtain a room that, including balconies, will provide seating accommodations for 750 people. Utility of the space has been increased by means of folding doors to divide the room into two smaller rooms.

Since the available space gave the room both a size and a somewhat unusual shape which, with the balconies, would cause difficulty in satisfactory hearing throughout the room, the Laboratories were asked for assistance on the acoustics of the room and the sound system to be provided. The acoustical problem was primarily one of making the room a place where speech, both direct and reproduced, could easily be understood. In addition, music was to be considered from transcriptions, sound motion pictures, and concerts.

Construction changes necessitated refinishing of the entire interior, making possible a complete acoustical design and giving freedom to use materials having good acoustical characteristics as well as suitable appearance. The result is a room that combines beauty and excellent acoustics.

One of the important factors affecting the acoustics of a room is the length of time it takes sound to die away. A sound generated in a room is reflected from the surfaces of walls, floor and ceiling a number of times, some of its energy being absorbed at each reflection. In a *live* room the energy absorbed at each reflection is small, and the sound continues for a relatively long time; in a *dead* room, the energy absorbed per reflection is large and the sound disappears quickly. This continuation of sound is called

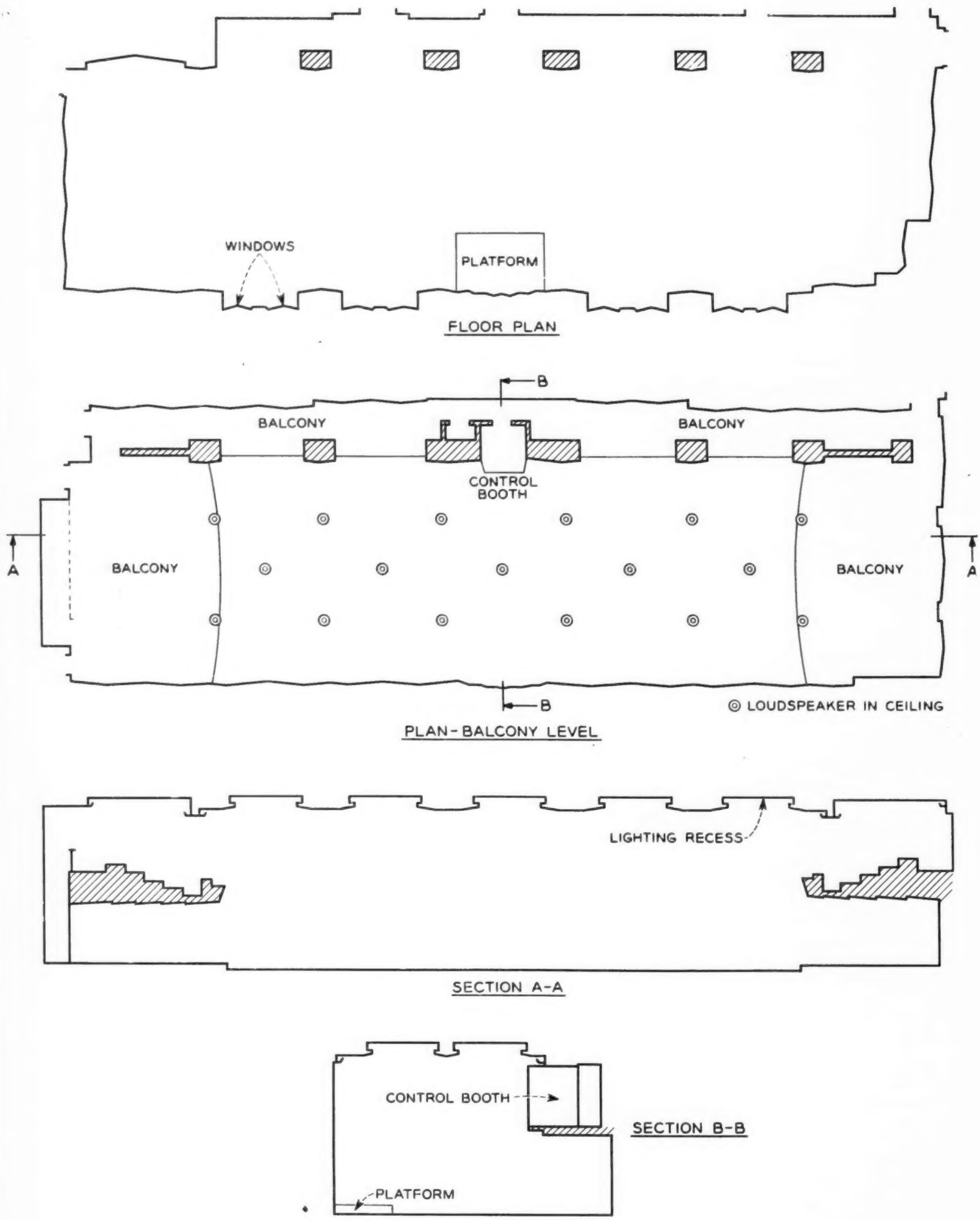


Fig. 1—Plan of Assembly Room. Angles of panels on side walls exaggerated for illustration purposes.

reverberation and is measured by the *reverberation time,* which is defined as the number of seconds it takes the sound energy to decrease 60 decibels after its source has been cut off.

The amount of reverberation permissible in a room varies with the size of the room and its purpose. In general, some reverberation is desirable in rooms intended for listening to music, and more reverberation is permitted at the lower frequencies as compared to the higher, because the reflected sound adds to the musical effect. Less liveness is desired for speech because the reflections tend to interfere with the easy understanding of the words spoken. In this case, the requirement of a room good for speech calls for keeping the reflected sound low, particularly at the lower frequencies where excessive reflections make a room sound hollow or "boomy." The somewhat unusual design objective chosen was 0.8 second reverberation time at all frequencies from 100 to 5,000 cycles when the room is occupied by about two-thirds of its maximum seating capacity of 750 people.

Reverberation in a room is controlled by the amount of sound absorbed by the interior surfaces of the room and by the furnishings and occupants. Little sound is absorbed by hard surfaces such as wood, glass and plaster, while a great deal is absorbed by carpet, soft furniture, and people. If the normal construction materials of a room and its furnishings have insufficient absorption, special acoustical material may be added to attain the desired results. The objective of a reverberation time of 0.8 second over the entire frequency band is a difficult one because people and the more common acoustical materials absorb a greater percentage of sound at higher frequencies (500 cycles and above) than at the lower frequencies. Hence, if enough material is used to give the desired characteristics at the lower frequencies, the room tends to be too dead at the higher.

To accomplish the objective, a somewhat unique dry-wall construction was used for all side walls and the end walls below the balconies. This consisted of cement asbestos board, ⅛ inch thick, mounted on 2-inch by 4-inch studding on 2-foot centers, both horizontally and vertically. Behind this relatively thin wall board, and separated from it by an air space, was hung a fairly dense rock wool layer, 2 inches thick, as shown in Figure 2. The constants of these wall board panels are such that they will vibrate as diaphragms at lower frequencies, causing absorption of energy by the resistance in the panels and by the rock wool behind them. At higher frequencies, the mass of the panels prevents much vibration, and therefore most of the energy at these frequencies is reflected. For appearance, a light canvas was glued to the surface of the wall board and painted, giving the appearance of a plaster wall.

For the end walls above the balconies, perforated wall board backed by rock wool was used to get as much absorption as possible at all frequencies. This was done to eliminate any echo from sound originating at the opposite end of the room during motion picture or stage presentations. An additional 1,000 square feet of similar material, located in the recesses above the lighting fixtures, provided the remainder of the absorption needed.

Some of the other features of the acoustical design may be seen in Figure 1. The side walls and columns are angled to break up reflections and eliminate parallel surfaces which might cause a "twitter" from repeated reflections. The under-balcony ceiling is angled to help reflect sound originating there out into the room, and to reflect sound from the rest of the room down at the people under the balcony.

Part of any complete acoustical design is the consideration of noise. Maximum noise requirements were specified for the fluorescent lighting equipment, and for the ventilating system whose ducts terminate in openings above the lighting fixtures. These requirements were 45 decibels for the lights and 50 decibels for the ventilators, measured three feet below the lighting fixtures with a standard sound meter having a reference level of 10^{-16} watts per square centimeter. Sound absorbing material was specified for the ceilings of the corridors adjacent to the room, to deaden the noise of footsteps and conversation. Separate inside windows, well weather-stripped, were added to help keep out street noise. Chairs with cushioned feet are used to reduce incidental noise within the room.

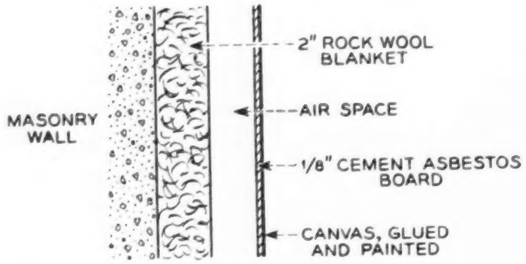


Fig. 2—Section through the side wall.

The size of the room (over 90,000 cubic feet) and the somewhat excessive length as compared to the width and height, call for the use of a sound system to reinforce the voices of the speakers. The sound system problem was to permit people to hear easily, anywhere in the room, under the conditions of (a) speech from the platform centered on the north side of the room, (b) speech from a stage presentation at either end of the room, (c) speech from members of the audience anywhere on the floor, picked up by microphones in the audience, (d) speech and music in connection with sound pictures, and (e) speech and music from phonograph, radio, or wire lines.

Primary sound coverage is obtained from a number of Western Electric direct radiator loudspeakers mounted in the ceiling and pointed straight downward. Seventeen of these loudspeakers, located as shown in Figure 1, are used for the high central portion of the room. Additional loudspeakers, similarly mounted and operating at lower power, are used in the low ceiling areas over and under the balconies. This arrangement gives even sound coverage over the entire floor area; measurements with a sound meter and warble frequency tone gave a level variation of only 2 decibels over the entire seating area.

The effect of this type of coverage on a remote program such as music from a phonograph record is one of being surrounded by sourceless sound and is very pleasant. Moreover, when the source of sound is local, such as speech from the platform, the illusion that the sound is coming directly from the talker is very good as long as one can see him.

An additional Western Electric loudspeaker, powerful enough to cover the entire room, is mounted in the center of the front of each balcony. Either of these may be used in place of the overhead group for occasions such as stage shows or sound pictures, where it is desirable to have all the sound coming from one end of the room.

Standard high quality Western Electric amplifying equipment is used for the remainder of the sound system. Programs may be obtained from microphones in the assembly room or from a phonograph or radio located with the amplifier equipment in the projection booth. Two channels are provided so that one is available for each portion of the room when the folding doors are closed; the second channel serves as a standby when these doors are open.

An interesting feature of the sound system is the provision for audience participation in affairs such as the stockholders' meetings. This arrangement of the system is shown in Figure 3. An array of four hanging microphones is provided over the platform to give the chairman freedom to move about. As many microphones as needed, up to a maximum of 25, are placed around the floor and in the balcony. When a member of the audience is recognized by the Chair, he moves to the nearest microphone, which is then turned on by an operator located in the glass-fronted control booth on the balcony opposite the platform. Two separate input channels are provided, offering separate gain controls for the platform channel and the floor channel. A signal light mounted in the microphone stand indicates when the asso-

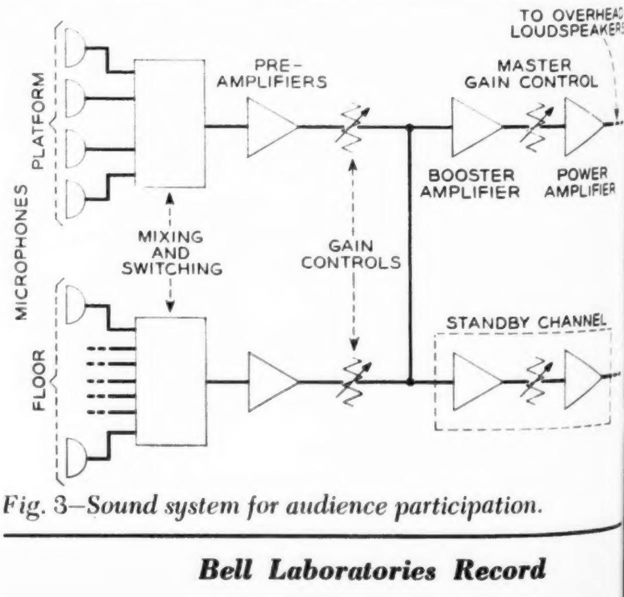


Fig. 3—Sound system for audience participation.

THE AUTHOR: L. B. Cooke joined the Laboratories in 1921 and, with the Commercial Products Department, engaged first in the development of radio receivers and then in the design of circuits for power line carrier telephone equipment. In 1928 he turned to the development of circuits for reproducing equipment such as sound pictures, public address systems, speech input systems and, during the war, battle announcing systems for naval vessels. Since the war he has engaged in the design of special sound systems such as the one described in the accompanying article and in consultation with the telephone operating companies on sound system and acoustical problems.

ciated microphone is in the circuit. Due to the distributed loudspeaker arrangement used, the energy from any one loudspeaker is low; it is possible to use a microphone anywhere on the floor, even directly under a loudspeaker, without trouble from acoustical feedback.

Tests of the completed room showed that the design objectives were met. Favorable comment after the first use of the room for a stockholders' meeting indicated that the primary objective—that of a room in which it is easy to hear and understand speech—had been accomplished; successful concerts later proved that the acoustics of the room were equally satisfactory for music.

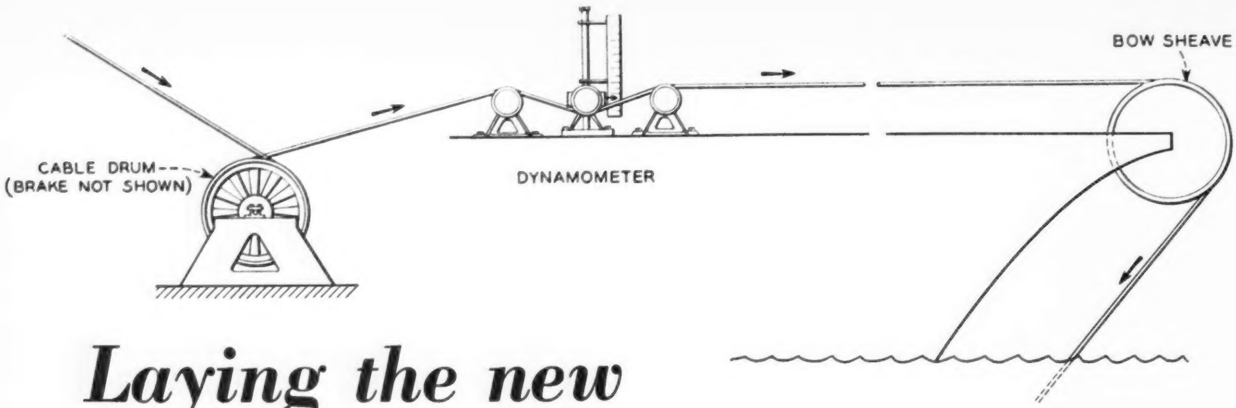
Subscriber Long-Distance Dialing

Transcontinental subscriber dialing will get its first commercial trial this fall in Englewood, N. J. At this time any of the ten thousand subscribers in the Englewood exchange will be able to dial directly any of some eleven million subscribers in and around San Francisco, Chicago, Cleveland, Detroit, Boston, Philadelphia, Providence, Milwaukee, Oakland, and Sacramento.

Some of the features and problems of nationwide dialing by operators were described in the Record for May of this year. Operator long-distance dialing is already in use in a number of localities, and is rapidly being extended. The step to subscriber long-distance dialing, however, brings in many additional problems, and the Englewood trial was projected largely to obtain more direct information regarding the many complexities that beset subscriber long-distance dialing in regular commercial service.

To reach a number in a distant city, such as GArfield 1-9950 in San Francisco, a subscriber in Englewood dials ten digits: 318 to reach the San Francisco area, and then GA 1-9950 to reach the desired office and the number in that office. The only time required is that for the subscriber to dial the ten digits and for the distant subscriber to answer. While the dialing is going on, automatic message accounting equipment records the calling and called numbers and other pertinent information, and later will also record the time the distant subscriber answers and the time the conversation terminates. Other AMA equipment then prepares the information for billing.

The Englewood installation marks another step forward in the steady progress in switching development made by Bell engineers. The first coast-to-coast dial call took place in 1947 when engineers at the Laboratories made a single-operator call from New York to San Francisco. Commercial toll dialing of transcontinental calls by operators began in 1949. By 1950 more than one-third of all long-distance calls were being handled by this method.



Laying the new Key West-Havana submarine cable system

N. C. YOUNGSTROM
Transmission Development

Laying a submarine cable is a combination of planning, experience, and navigation. And when the cable is further complicated by having built-in repeaters—being the first cable so equipped—lack of experience must be offset by more intensive planning.

A part of this planning was to determine the practicability of laying the repeaters as an integral part of a submarine cable. By the time this stage of the program had been reached, developments had produced repeaters capable of meeting the design objectives. The remaining item, therefore, was to learn if the repeatered cable could be laid—and would work satisfactorily after it had reached the ocean bottom.

Deep sea handling trials were made off the Bahamas using the Western Union Telegraph Company cable ship *Lord Kelvin*. On these trials the practicability of laying repeaters as an integral part of the cable was established, and suitable handling techniques were developed to minimize hazards to the repeater. Because of the experience of the officers and crew, and the special equipment on board, the *Lord Kelvin* was the logical choice of vessel to lay the new Key West-Havana system.

Fig. 1—Above, schematic of the conventional dynamometer used in laying submarine cable.

An important requirement of this project is that the distances between the repeaters and the shore, and between repeaters in the cables, must be held to close limits because of the attenuation along the cables. This made it necessary for the ship to follow accurately a predetermined course and to lay a specified percentage of slack. The presence of eight older cables to the eastward of the selected course was another need for accuracy, because possible repair work on these cables, with its attendant grappling, would be a hazard to the new cables; hence the new ones were laid in an accurately charted position well clear of the older cables.

Following a predetermined course in the strong cross current and uncertain eddies of the Gulf Stream required expert seamanship and careful navigation. Mark buoys spaced as required provided floating "land marks" upon which practically continuous ranges and bearings were taken by the navigating officer to determine the ship's progress. Closely dependent upon this exact navigation and predetermined

course was the important matter of determining the per cent slack as the cable was paid out. Controlling the percentage of slack is a matter of skill and experience in handling the tension, speed of payout, and speed of the ship, to insure that the cable will lie on the irregular bottom without residual tension. In some cable laying jobs, a taut piano wire has been used to establish the true distance over the ocean bottom for comparison with length of cable paid out, but this is troublesome because of frequent breakage of the wire and it is not particularly suitable on a job having frequent changes of course and a strong cross current. In laying the repeatered cable, the tension in the cable as it left the ship was adjusted with due consideration of the depth of the water, so that the proper amount of slack was obtained by the length of cable paid out compared to the distance traversed.

Tension in a cable as it leaves the ship has been established mathematically as equal to the weight in water of a length of cable equal to the depth of water below that point, plus the tension at the bottom, less an amount due to the friction of water against the cable. If the cable is being paid out at a rate faster than the progress of the ship, the tension at the bottom becomes zero and the tension at the ship becomes less than the weight of a length to the bottom by a percentage that is a function of the cable friction, relative velocities, and the angle at which the cable sinks. A need is therefore indicated for a precise means of measuring tension changes.

The conventional dynamometer is shown schematically in Figure 1. It is relatively insensitive at low tensions and is equipped with sheaves having a radius that is too small for the repeaters. For the Bahamas trials, the starboard cable handling equipment on the *Lord Kelvin* was modified to accommodate the repeatered cable, enlarging the cable drum and replacing the dynamometer sheaves by a single "caterpillar" tread. This tread was mounted on a hinged carrier provided with an electrically sensitive pressure cell suggested by C. A. Chase. The output of the cell was fed into a graphic recorder of fast response. Although this arrangement worked satisfactorily, an improvement was designed by H. L. Thal of the Research Department using a continuous rim turning on rollers and passing through adjacent hatches. The rollers were mounted on a pivoted frame under which the pressure sensitive cell was placed to determine the cable tension. The electrical output of the pressure cell was connected to a recording instrument, from which indicators on the forecastle deck and on the bridge were operated by synchro motors. Figure 2 shows the cable passing over the rim. When the ship was not laying cable, the openings in the hatch covers were closed by a heavy steel hood covering the installation, a requirement that was set by both the insurance inspector and safety considerations.

Eliminating the small sheaves of the dynamometer makes it possible to lay and recover cable from great depths without impairing its handling and coiling proper-

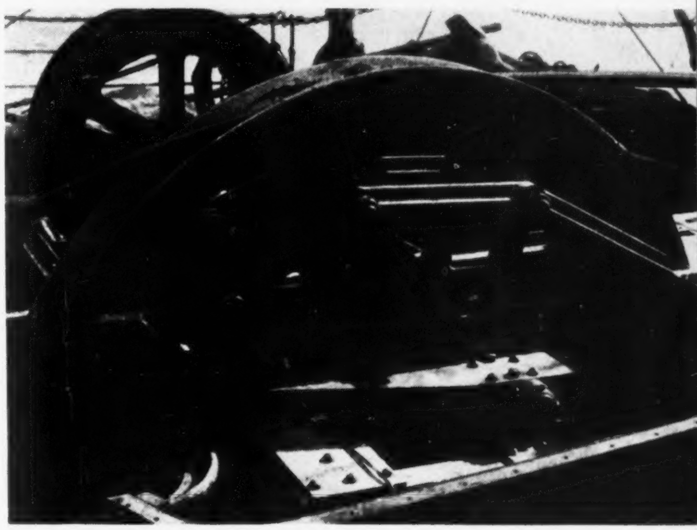


Fig. 2—The cable passing over the continuous rim of of the new dynamometer.

ties. Cable being laid or picked up twists in the direction of unlaying the armor wire. As the turning cable passes the three small sheaves, each kinks it in a manner tending to produce a helix. This distortion may prevent it from being coiled down into the ship's cable tanks. With the arrangement of Figure 3, cable of the type used between Key West and Havana has been laid and recovered repeatedly in water as deep as

2,000 fathoms without impairing its mechanical or electrical properties.

In planning the laying of the cable, it was necessary to consider, at an early stage, the requirements of the ship itself. The cables with the repeaters had to be stowed in the ship's tanks, with proper regard for the disposition of the entire 908 tons of cable. It was therefore necessary to lay the cable mentally and work back all the way to the cable factory, considering all handling and temporary storage during manufacture so that each length would be produced in proper sequence so as to appear in the railroad cars at the ship's dock according to the loading plans. The weight and space required for even the shortest length of this cable precluded the possibility of moving it about except in accordance with a predetermined handling plan.

While loading the ship, testing equipment and measuring devices were installed, and on the voyage to Key West, high-frequency transmission tests and insulation measurements were made on the cable and repeater systems. After reaching the cable grounds, mark buoys were placed at intervals of 3 to 15 miles to provide a continuous chain of land marks to guide the ship during laying. While placing the buoys, the character of the ocean bottom was checked by sonic fathometer readings and samples of the bottom and bottom temperatures were obtained at intervals.

Prior to the arrival of the ship, the shore ends of both cables were laid in the shallow water from Key West to Sand Key, a distance of about 8 miles, where they were sealed and marked by buoys. The route for these cables, identified as Sections I and V, had been selected to avoid the 8 older working cables.

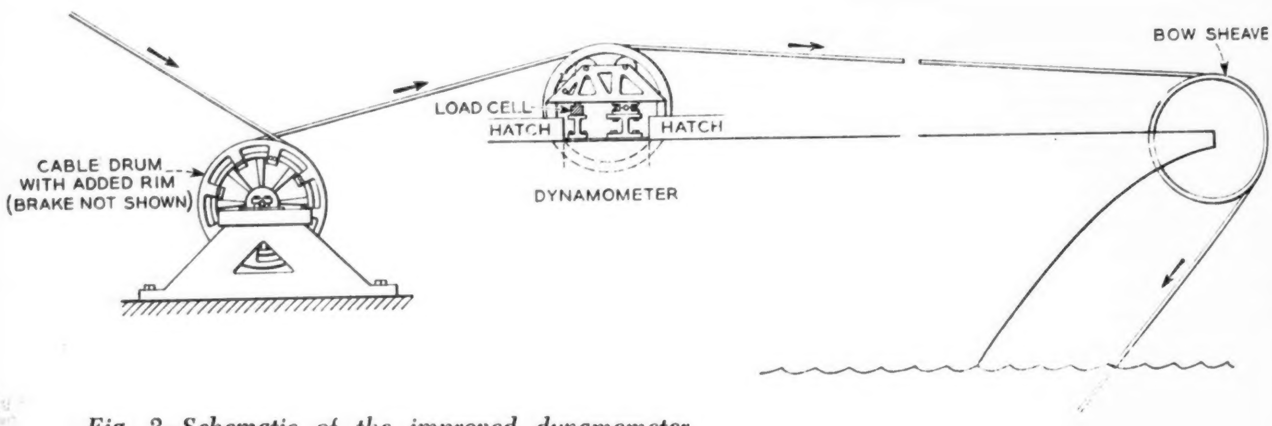


Fig. 3—Schematic of the improved dynamometer.

The work of loading the ship had to be very carefully done, coiling the cable down into the tanks in a manner that would avoid kinking as it was paid out. Joining-in of the repeaters was done on shipboard prior to placing them in the tanks.

Loading the repeater sections presented a special problem in that they constituted a mechanical discontinuity that made them subject to kinking while being handled. Wooden splints were attached to them temporarily, and then removed after the repeater was placed inside the tank. During the laying operation, however, the repeater left the tank as naturally as the cable to which it was attached.

The program for laying the deep water sections called for the remaining sections of the cable to be laid as continuous lengths in the following order:

Section II—(32.09 n.m.) from the buoyed end of cable No. 5 (transmitting from Key West to Havana) near Sand Key to the position selected for the final splice.

Section III—(74.64 n.m) from Havana to the final splice, completing cable No. 5.

Section IV—(112.32 n.m.) cable No. 6 (transmitting from Havana to Key West) from Havana to the position selected for the final splice.

Section VI–(4.05 n.m.) from the buoyed end of cable 6 near Sand Key to the final splice, after splicing in the repeater at the buoyed end.

The order and direction of laying were based upon the experience with the 1920 and 1930 cables; selecting the points for the final splice where they would be safe from ships' anchors, away from the sloping bottom near Havana, and relatively free from cross currents.

Actual deep water laying began after the cable on board ship was spliced to the shore end of cable No. 5. After Section II was in the water, with the end sealed to permit making periodic insulation tests, laying of Section III from the Havana end was started.

The cable ship was anchored about 300 yards off shore and a messenger wire used to pull the heavy shore end of the cable from the ship, using a number of barrels as floats for the cable. Because of the rocky bottom, the last repeater was placed in a concrete vault on the shore, and the connection to the cable made at that point. After electrical tests, the barrels attached to the cable were cut away, allowing it to settle into a predetermined position on the bottom. Laying of Section III then proceeded as the ship steamed northward, adjusting cable tension as the depth of water, speed of the ship, or weight of the cable changed. Adjustments were also made to provide the required slack.

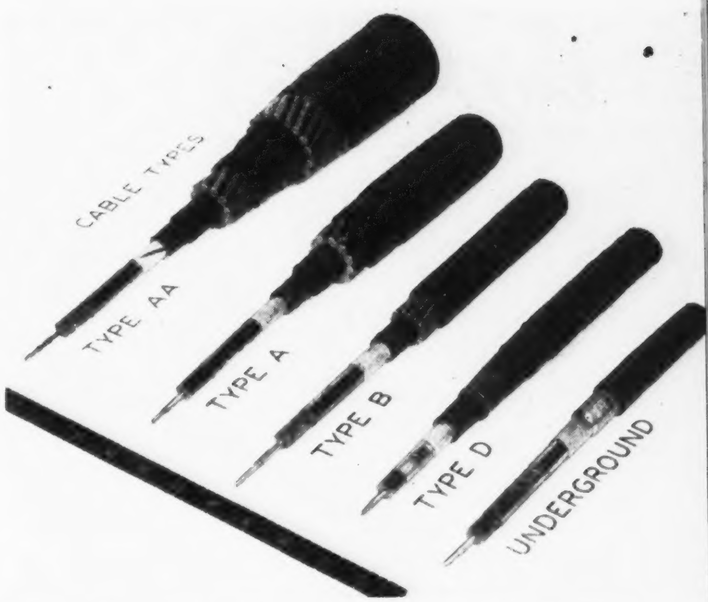


Fig. 4–Types of cable used in the new Key West-Havana system.

As the repeaters were reached in this section, they were carefully paid out at reduced speed, maneuvering the ship so that the repeaters did not rub against the side of the vessel. When a repeater reached the cable drum a hardwood block (not shown in Figure 3) was pressed against it to force it to conform to the circumference. After the repeater passed on to the drum, the normal back tensioning device held the repeater and cable in tight contact with the drum. Transmission and routine insulation measurements were made during the laying of all lengths.

THE AUTHOR: Before receiving his B.S. degree in 1921 from the University of California, N. C. Youngstrom spent the summer of 1920 with the Pacific Telephone and Telegraph Company, taking the student training course. After graduation, however, he worked elsewhere before returning to the Pacific Company in 1924. As a member of the Division Transmission Engineering Department, he became involved in the early carrier equipment. Transferring to the Laboratories in 1928, he worked first on long-wave radio and privacy systems, and in 1935 moved to Whippany for broadcast transmitter development. Then in 1939, he took part in the N. Y.-Phila. coaxial system installation. As a reservist in the Navy, he was called to active duty in World War II, spending two years as Materiel officer in Harbor Defense problems in New York; then doing the same type of work in North Africa and the Western Pacific. In these jobs, he became concerned with the laying of submarine cable. Returning to the Laboratories in 1946, his experience was put to use in the development, manufacture, and laying of the Key West-Havana repeatered submarine cable. He is now engaged in a cable project for the U. S. Government.

Cable for the several lengths differed in mechanical design depending upon their locations in the system. Figure 4 illustrates the several types. Type AA, the heaviest, uses a reinforcement of 18 No. 1 (0.3 inch diameter) gauge galvanized wire laid over Type A cable, to provide additional protection and weight for the Havana shore ends which are exposed to heavy surf. These ends are further protected in the last 6 to 12 feet of depth by interlocking split cast iron pipe sections placed over the cables by divers. Type A is a more or less standard shore end having an armor of 11 No. 1 (0.3 inch diameter) gauge galvanized mild steel wires. It is used in relatively shallow water. Long experience with the other four cables at the landing in Key West indicate that this armor is adequate for that location. The only special protection here is a trench blasted through the rock near the waters edge. Type B is an intermediate armor having 15 No. 8 (0.165 inch diameter) gauge mild steel armor wires and is used in moderate depths. Type D is a deep sea cable having 22 No. 14 (0.083 inch diameter) gauge high tensile steel armor wires. It can be laid and lifted in the deepest water.

When the final splice was completed, 223.1 n.m. of cable had been laid. The cables were laid with a total of 0.40 n.m. more than the calculated lengths, a tribute to the skill of the ship's personnel in determining the amount of slack let out and in following so exactly the prescribed route. The average speed of laying was 5.1 knots and at times reached 6.3 knots. Altogether, the laying operation required just under 44 hours, with the longest continuous run being 20 hours and 17 minutes.

Western Electric 5755/420A Electron Tube

A recent addition to the increasingly popular family of miniature tubes is the Western Electric 5755/420A. This is a double-triode tube having separate indirectly heated cathodes.

This tube has been designed for use in the first stage of D-C amplifier circuits in computer service and other applications requiring a tube having a high order of mechanical and thermionic stability as well as a long life expectancy. Special design techniques have been employed to control thermal shifting of tube elements and other factors contributing to instability.

Typical operating conditions follow:

Heater Voltage	6.3 volts
Heater Current	360 milliamperes
Plate Supply Voltage	310 volts
Cathode Bias Resistor (Cathodes tied together)	150000 ohms
Plate Current (each section)	0.15 milliampere
Grid Current, Maximum (each section)	10.9 ampere
Load Resistance (each section)	0.9 megohm
Transconductance (each section)	500 micromhos
Amplification Factor (each section)	70

The 6A order turret

H. H. ABBOTT
Switching Engineering

In their needs for telephone service, large users such as business offices, stores, and manufacturing plants, differ widely, not only because of differences in the size of the establishments but because of differences in their type of work as well. In most cases one of the many forms of PBX's available meet the requirements satisfactorily. These provide both for completing local calls between members of the organization and for completing central office calls. For certain concerns, however, such as department stores, air lines, and telegraph companies, where large volumes of orders are received by telephone, a PBX alone is generally not sufficient; some method is needed of distributing incoming calls to a group of order takers in such a way that the calls will be answered promptly and in approximately their order of arrival, and that they will be distributed as uniformly as possible among the various attendants so as to secure efficient operation.

For this type of service, the order turret or the key equipment is provided, the latter in general being used for the smaller installations. The 1A key telephone system* with six button key telephone sets is frequently employed for small groups of attendants. For larger groups of attendants, the 101-type key equipments are employed. For still larger groups of attendants, the No. 2 order turret—consisting of a group of jacks, lamps, and cords, and associated equipment in a turret serving four attendants—has been used in situations where there are less than about twenty attendants in a group and the desks used by the attendants will accommodate this relatively large structure. Where the order desk provides space for only a small amount of telephone equipment, and the calls to the attendants are completed through a PBX, No. 4 order turrets, small key boxes each about the size of a six-inch cube, have been provided—one for each attendant. The No. 3 order turret system was developed for the largest installations. This system has an

Fig. 1—Shown in the photograph above, a 6A order turret installation in a large department store.

*See bibliography on page 375 for articles on Key Equipments and Order Turrets that have appeared in the RECORD.

Fig. 2—Where convenience indicates, the key box may be mounted flush with the attendant's desk.

appearance, from the attendants point of view, similar to that of the No. 4 order turret, but behind the scenes it includes special automatic switching equipment to distribute the incoming calls.

The No. 6A order turret system has now been made available for use instead of the No. 3. This new system has the principal advantages of lower cost than the No. 3

Fig. 3—For some installations the key set is in a small cabinet resting on the desk.

and greater capacity—198 trunks and 200 attendants positions. Development work on it was initiated in the summer of 1941, and the first installation of an early version, known as the No. 6 order turret, was in service for Montgomery Ward and Company in Chicago before Christmas of that year. Soon thereafter, the war necessarily deferred further progress on its development. However, its basic switching principles were adapted to the modernized information desk for large PBX's installed for the War Department and National War Agencies in Washington.

The 6A order turret system is an automatic call distributing system using step-by-step trunk finders which connect trunks to

Fig. 4—The attendant's key box for the 6A order turret

key boxes at the attendants positions. Most of the incoming trunks are usually from subscriber line terminals in a nearby central office, but some of them may be from a nearby PBX and from more remote central offices. A single central office number applies to a large group of trunks. The incoming calls are completed to the attendants in the approximate sequence of their arrival by means of relay gate circuits that arrange the calls in groups and complete all calls in one group before any calls are answered in a subsequent group. Similar relay gate circuits cause these calls to be distributed evenly among all the attendants available to answer them.

A typical operating room with a group of

attendants receiving calls through a 6A order turret system is shown in Figure 1, and a closeup view of a key box at one of the attendants positions is shown in Figure 2. This key box is mounted so that the face plate containing the keys is flush with the table top. In other types of installations, the key box may be mounted in a turret on top of the table as shown in Figure 3. Functions of these keys are more clearly indicated in a closeup view of the key box in Figure 4.

To make the position available for an incoming call, the attendant plugs in her telephone set and operates key number 1 (counting from the left) down to the intermediate or talking position. The connection of a call to the position puts a momentary tone on her line and lights the green trunk lamp—the upper of the two lamps at the right of the key set. The attendant at once answers. Should she need to get information from some other department, she operates the No. 2 key, (designated WA9-1111 EXT. 213) to the TALK position to reach the PBX equipment. If it is a dial PBX,, the attendant operates the No. 1 key (designated TRUNK) to the lower, or HOLD, position while she is dialing. When she has finished with the call on key No. 2, she restores this key to normal. When she is finished with the incoming call, she restores the No. 1 key to the normal position, and the trunk lamp goes out. Her position will not be seized again, however, until No. 1 key is again operated to the talk position and all other keys are normal.

The third key from the left (designated WA9-1234) connects the position to the central office. This enables the attendant to make outgoing calls when she is not busy on incoming calls. It would, for example, permit an attendant to call back a customer who desires information in connection with an order already given. Each of the first three keys has a normal, a talk, and a hold position, and conference connections may be set up by operating either No. 1 and No. 2, or No. 2 and No. 3 keys to the talk position at the same time. A conference connection is not possible between the incoming trunk, No. 1 key, and the central office trunk No. 3 key.

The fourth, or right hand, key (designated TRANSFER SUPV) is used for transferring a call or for attracting the attention of a supervisor. When operated to the upper or transfer position, this key brings in the PBX attendant who may then be told how the call on the incoming trunk is to be transferred. The lower or SUPV position of the No. 4 key is used to signal a supervisor. At Telegraph Companies this key position

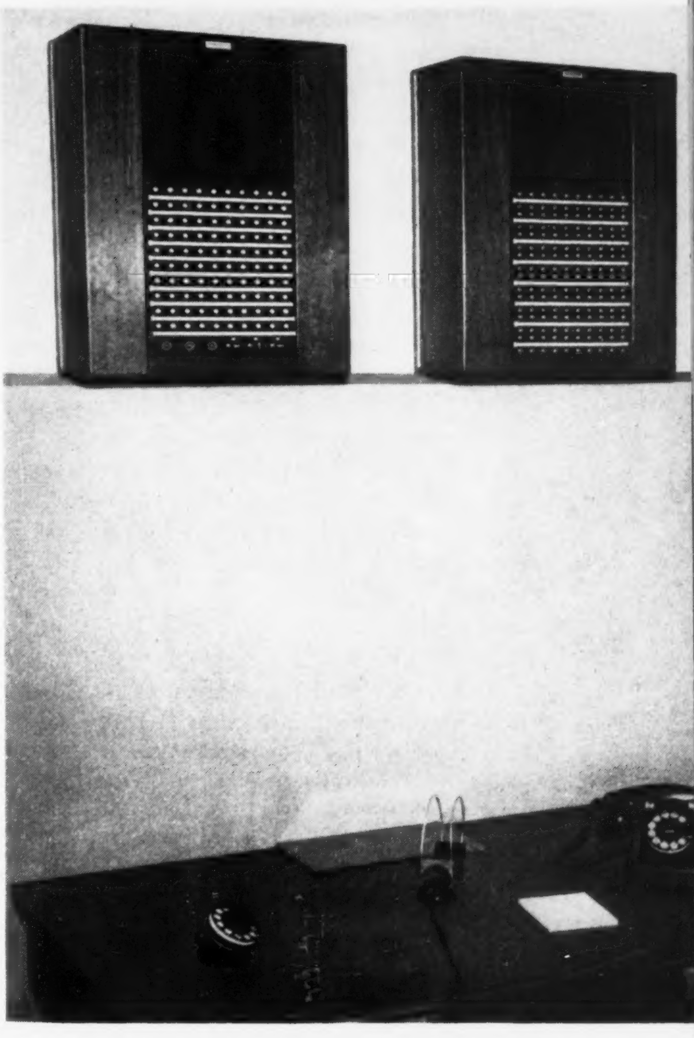


Fig. 5—A supervisor's position showing two lamp cabinets.

may be designated FLASH instead of SUPV and arranged to flash the cord-circuit lamp of the central office operator. This flashing feature is used to coordinate the collection of a telegram fee when the telegram originated at a coin telephone. The lower lamp at the right, which has an amber cap, lights

when a call is waiting to be handled and all attendants' positions are busy.

Besides the keys and lamps at each attendant's position, the 6A also includes a separate lamp cabinet to help in supervising the operation of the system. Its lamps indicate the load on the system and how promptly calls are being handled, so that the number of attendants on duty can be proportioned to the load. One of these cabinets may be seen at the upper left of Figure 5. It includes a white lamp for each incoming trunk, and a green lamp and a red lamp for each attendant's position. The trunk lamp lights while an unanswered call is waiting on a trunk. The green position-lamp lights while a position is available to receive calls. The red position-lamp lights while a position is occupied but the attendant is busy on outgoing calls or other work and has made her position unavailable to receive calls. In addition there are three trouble alarm lamps to indicate a circuit failure, a power-plant failure, and a fuse failure, respectively. A buzzer for use during periods of light loads sounds when calls are waiting and no position is available to handle them. It may be made inoperative by a buzzer cutoff key in the cabinet. There is also a trouble alarm that sounds when any of the trouble lamps light, and a trouble alarm key for making it unoperative. In addition there is a battery cutoff key to eliminate current drain when the system is not in use.

Where there are so many positions that a single cabinet will not accommodate all the lamps, a second cabinet is required for additional lamps. One of these may be

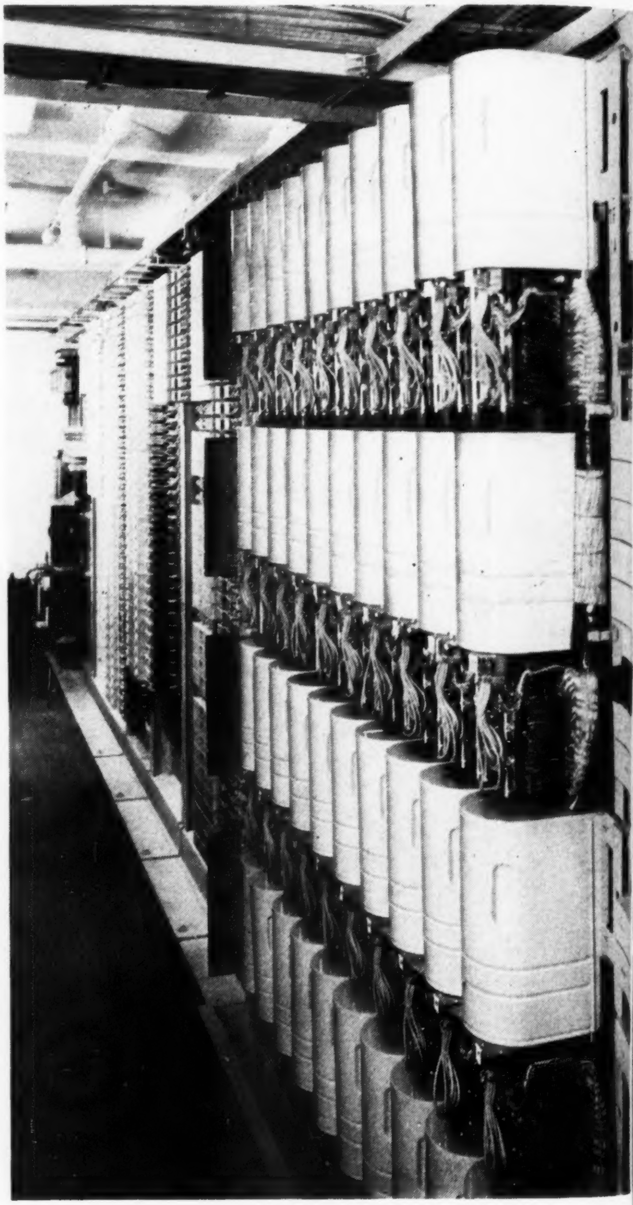


Fig. 6—Switching equipment for the 6A order turret.

THE AUTHOR: Henry H. Abbott entered Long Lines in 1920. The following year he returned to Ohio State University and in 1923 graduated with the degree B.E.E. Returning to the A T & T he entered the Department of Development and Research where he engaged in the development of manual and dial central office and private branch exchange systems. In 1930 he received the E.E. degree from Ohio State. He came to the Laboratories during the 1934 consolidation and since then has been in the local facilities and switching engineering departments. Recently he has been in charge of the subdepartment concerned with planning developments in manual and small dial switching systems and all types of signaling systems.

Bibliography of Record Articles

No. 2 Order Turret. .	Vol. 7, Mar. 1929, Page 270
No. 3 Order Turret. .	Vol. 11, Sept. 1932, Page 2
The 101 Key Equip. . .	Vol. 15, Aug. 1937, Page 370
No. 4 Order Turret.	Vol. 17, Nov. 1938, Page 100
1A Key Equipment. .	Vol. 18, June 1940, Page 315
No. 6 Order Turret. .	Vol. 22, Jan. 1944, Page 218

seen in the upper right of Figure 5. Trouble lamps and cutoff keys, however, are all in the first cabinet.

Associated with each of the attendants' positions is a step-by-step trunk finder that has access to all the incoming trunks. Besides these trunk finders, the switching equipment for the 6A order turret includes the incoming trunk circuits, the gating and control circuits to control the distribution of the calls, and a power supply. A view of the switching equipment for a typical installation is shown in Figure 6.

Installations of a 6A order turret are now operating in New York, Chicago, and St. Louis, and it is expected that many other systems will be furnished for various large business concerns this year.

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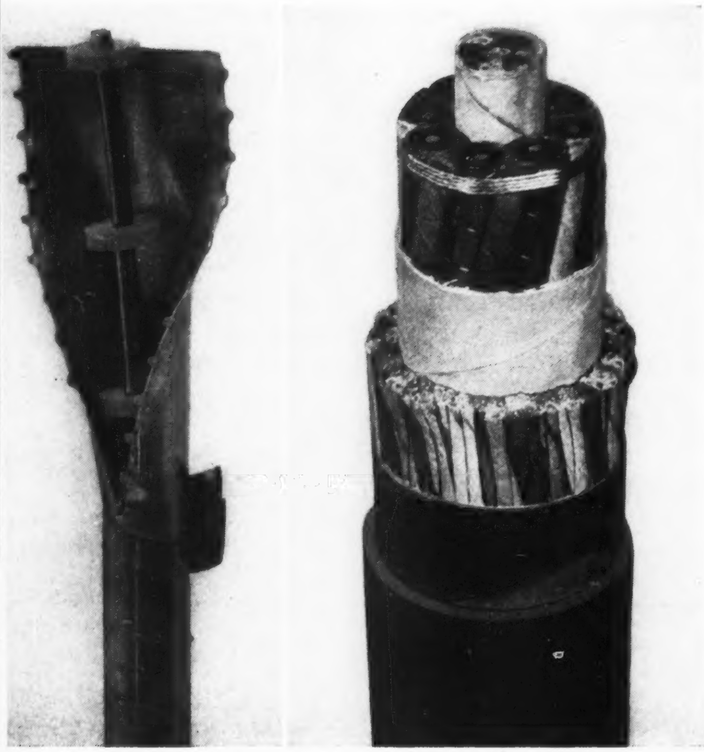
Improving corona voltage of coaxial cables

A. S. WINDELER
Outside Plant Development



Left, Photograph of a coaxial showing details of construction. Right, section of cable containing 8 coaxials and a layer of paper insulated quads.

Throughout the Bell System's nationwide network of coaxial cables, repeaters are spaced a few miles apart, and power is fed to them over the central wire of the coaxial. Since the power requirement of each section is accurately known and is invariable, advantage may be taken of a series system, in which the current is constant and the voltage falls from the power-supply point to the farthest repeater. As a result, the voltage from the central wire to the grounded outer conductor may be fairly high. It is, of course, economical to place power stations as far apart as possible. The distance is limited by the maximum corona-free voltage which can be placed on the coaxial unless this voltage is so high that other factors become limiting. This introduces problems in the design and manufacture of coaxial cable which have received much engineering study both in the Laboratories and by Western Electric.

In a theoretically perfect coaxial structure having the dimensions of the standard 0.375-in. coaxial, the dielectric breaks down without previous corona discharge. However, no practically manufactured coaxial presents perfectly smooth surfaces without points at which the air or nitrogen dielectric is stressed until ionization begins. The dielectric strength in the 0.375-in. coaxial is considerably lower than that calculated for a structure having smooth conductors and air dielectric. For a coaxial structure at atmospheric pressure, the dc breakdown voltage E is given in kv by the following formula:

$$E = 90.65\left(1 + \frac{0.2671}{\sqrt{d}}\right) d \log \frac{D}{d}$$

where D is the inside diameter of the outer conductor in inches and d is the diameter of the inner conductor in inches. For the 0.375-in. coaxial where d = 0.1003 inch and D = 0.371 inch, the theoretical breakdown voltage is about 9.5 kilovolts dc. In the actual structure, however, the breakdown voltage is determined largely by the surface condition of the conductors, and on the average is about half of the theoretical value, with corona occurring several hundred volts lower. The dielectric strength requirement on reels of coaxial cable leaving the factory is 4.0 kilovolts dc. Although this may seem low compared to the theoretical 9.5 kilovolts, it was only through considerable effort that this value was achieved.

Most breakdown failures in a coaxial cable are caused by the presence of a splinter, sliver, or piece of scale on the inner or outer conductor. The work on dielectric strength improvement proceeded along two lines. On the one hand efforts were directed toward the prevention of slivers and splinters as far as possible by the selection and treatment of materials, and on the other hand toward the burning-off of such splinters and slivers as were inadvertently incorporated in the coaxial during manufacture. This latter process is known as sliver burning.

One of the early sources of low breakdown was found to be scale on the outer conductor, which would flake off after the coaxial was formed. This problem was solved by Western Electric Company engineers and Laboratories metallurgists working with the tape supplier to obtain scale-free tape. Another source of low breakdown was the presence of projecting slivers of copper on the inner conductor after the drawing process. These were eliminated by running the copper rod from which the wire is drawn, through a cylindrical cutting tool prior to drawing.

To remove any surface irregularities that may still remain on the conductors, sliver burning is resorted to both during and after the forming of the coaxial. To burn off slivers on the central conductor and foreign matter on the discs, three sets of electrodes are installed in each coaxial forming machine as shown in Figure 1. These electrodes subject the insulated central conductor to approximately 5 peak kilovolts ac before the outer conductor is formed. If a flashover occurs at either of the last two electrodes, the machine is automatically stopped and the operator inspects the conductor. If a disk is damaged, it is replaced.

After a length of coaxial is formed, it is tested for dielectric strength at 4.4 kilovolts dc. If it fails this test, it can usually be "cleaned up" by further sliver burning. In the beginning the apparatus consisted of a condenser charged to the desired voltage, and then discharged through the sliver in the coaxial. This worked well in most cases, but occasionally the explosive nature of the flashover disintegrated the sliver and sputtered the adjacent disk with copper, causing a permanent breakdown failure and, of course, a rejection.

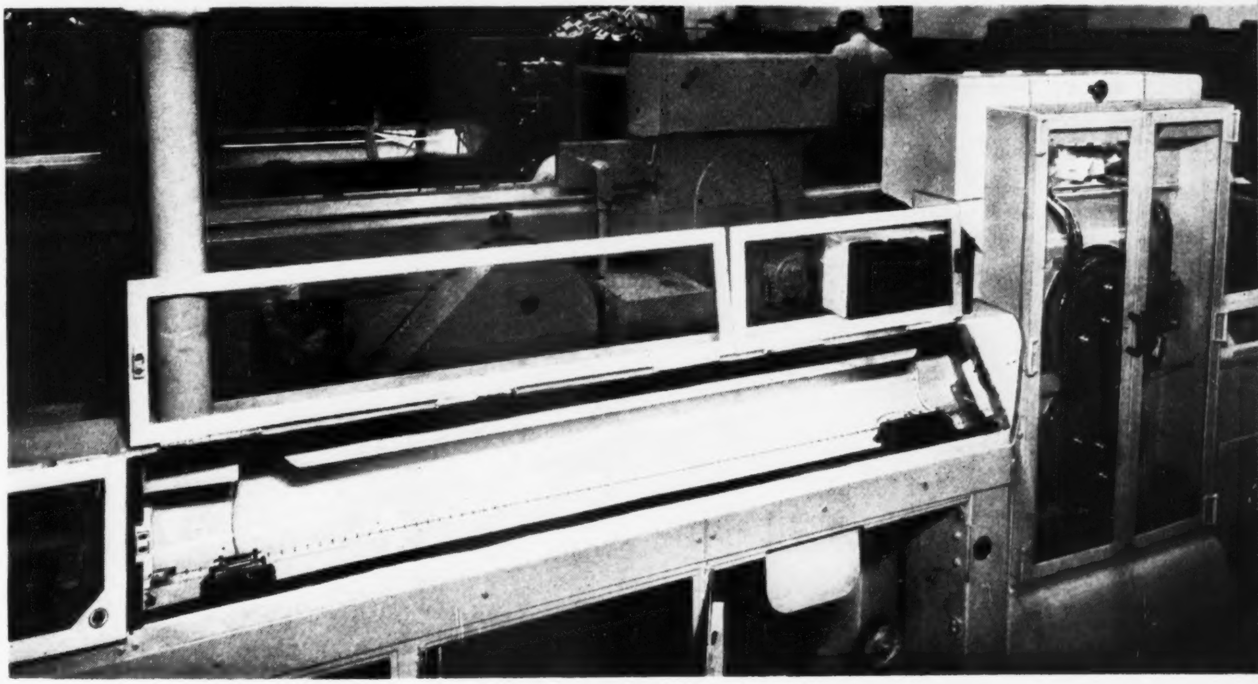


Fig. 1—Coaxial forming machine showing insulated center conductor (lower foreground) passing through high-voltage electrodes.

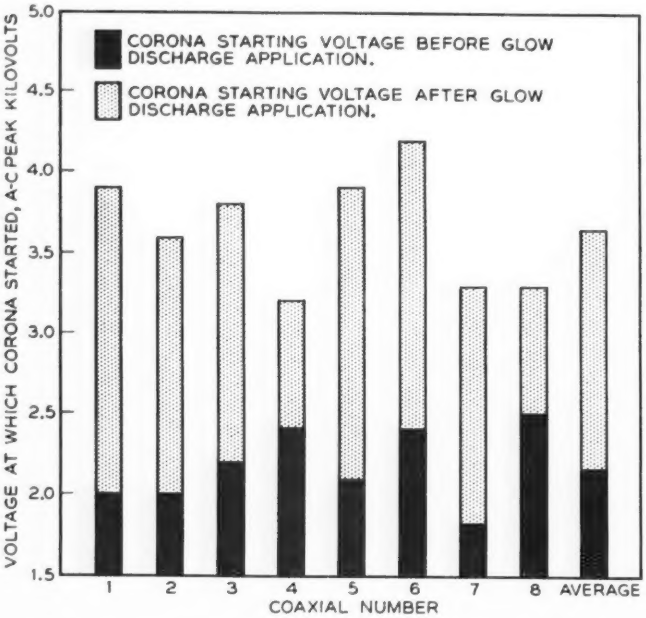


Fig. 2—Improvement of critical corona voltage due to glow discharge sliver burning.

To overcome this difficulty the so-called "glow discharge" method of sliver burning was developed. In the glow discharge method, the rate of discharge of the condenser through the sliver is slowed down; the current is limited so that the flashover is in the nature of a glow discharge instead of an arc. The slowing down of the condenser discharge is accomplished by placing a resistance in series with the condenser. Because a portion of the energy is dissipated in the resistance, the size of the condenser is increased to supply the extra energy that is required.

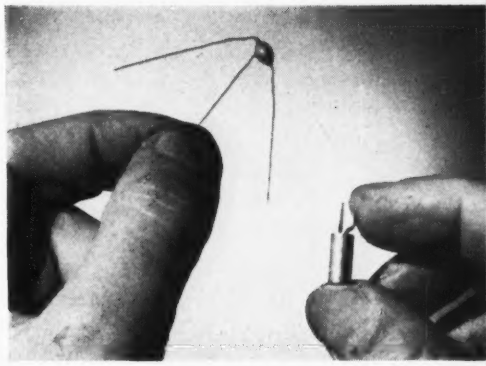
The glow-discharge burning method permits the use of higher voltages without damaging the disk, and the use of higher voltages makes it possible to detect potential defects at a stage in the manufacture where they can be eliminated at no great expense. After the single coaxials have been stranded, sheathed, and armored to form a completed cable, the occurrence of a defect is more costly to detect, since the cable must be cut at the defect and spliced later in the field.

Sliver burning by the glow discharge method results in a marked increase in the voltage at which corona appears, i.e., in the critical corona voltage. The results on a typical reel of eight-coaxial cable are shown in Figure 2. The substantial improvement in critical corona voltage is a striking demonstration of the effectiveness of the glow-discharge sliver-burning treatment.

Unfortunately, the handling which the cable receives during installation decreases the critical corona voltage somewhat, and thus the full benefit of the cleaning-up process in factory lengths is not realized in the installed cable. Nevertheless, the installed cable is considerably better than it would otherwise be. Moreover, the treatment which the cable receives in the factory minimizes the sliver burning and other measures required in the field to achieve a cable that will transmit power at the required voltage without objectionable corona noise.

THE AUTHOR: A. S. Windeler was graduated from Rutgers University in 1930 with a B.S. degree and joined the Laboratories Technical Staff the same year. As a member of the Outside Plant Development Department, he engaged in cable development work at Kearny for a brief period before being transferred to Point Breeze to carry on with the same type of work. Among the developments with which he has been associated are type K carrier cable, coaxial cable, and video-pair cable. During the war, Mr. Windeler was concerned with the design and standardization of microwave cables.

The Junction Transistor

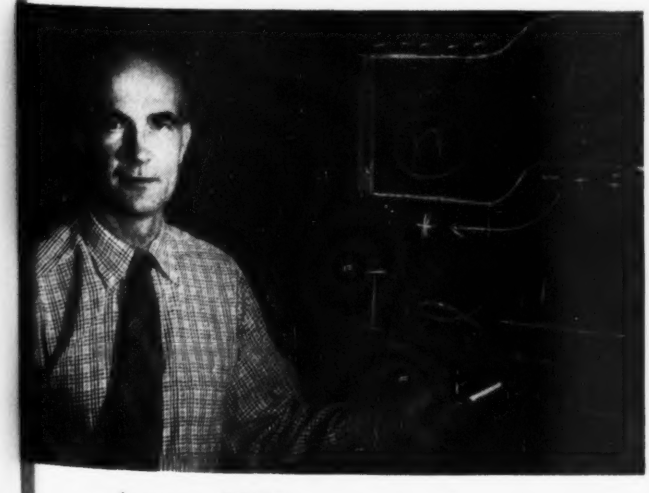


Significant advances in the development of the transistor, a tiny amplifying device which has been called the first serious rival of the vacuum tube, were recently announced by Bell Telephone Laboratories. The transistor was invented here three years ago. Most important of these advances is the construction of operating samples of a radically new type of transistor which has astonishing properties never before achieved in any amplifying device.

Its inventor, William Shockley, who initiated and directed the research leading to the original transistor, predicted the new type more than two years ago, as a result of complex theoretical studies he carried on as part of the Laboratories' broad investigations into transistor physics.

Performance of this new transistor is described in technical articles published in the July issues of the *Bell System Technical Journal*, the *Physical Review*, and the *Proceedings of the Institute of Radio Engineers*. Associated with Dr. Shockley and co-authors of the papers are Morgan Sparks and G. K. Teal, who built the first of the new type transistors, and R. L. Wallace, Jr. and W. J. Pietenpol, who have been working on their development.

W. Shockley worked out the fundamental theory for the new transistor.



Development work on the original type of transistor has been so successful that this type will be put into trial use in the Bell System. The Laboratories have made transistors of this original type which are as uniform in performance as vacuum tubes. This achievement is a very significant advance over the state of transistor work two years ago. At that time transistors were highly variable in their characteristics and of uncertain reliability.

As a result of extensive development under the direction of J. A. Morton, the problems involved in reliability and reproducibility are now understood and it is expected that regular production can be started. Transistors have been produced which can withstand shock and vibration better than any known vacuum tube and they are expected to have a service life considerably longer than that of commercial vacuum tubes in current use. The transistor can now be designed for a great many specific functions, and its ranges of performance have been extended to include a wide variety of applications which at present require commercial tubes of the vacuum type.

The transistor is also expected to find future application in telephone apparatus where the use of vacuum tubes is now impractical, for example, in the complex switching mechanisms which are the basis of the dial system.

These and other advances, which may be expected to have an important effect on the entire field of electronics, are the result of intensive laboratory work on the originial device. This is known as a "point contact" transistor, and consists essentially of two hair-thin wires resting on a tiny speck of germanium, which is a semiconducting metallic element. There is no glass envelope, no vacuum, and no heating element to cause a warm-up delay. The entire apparatus is housed in a metal cylinder about the size of a .22 caliber shell, although it may also be housed in a much smaller space for certain applications.

But in addition to making vast improvements in this original transistor, the researchers have now developed a radically new and in many ways more effective type of amplifier called a junction transistor. This is described in the technical papers, together with some developments in circuits for using it. Extremely efficient and rugged, this junction type is in the form of a small bead, about half the size of a pea.

G. K. Teal measures potential gradients in npn germanium . . . hundreds of such measurements had to be made in exploring different specimens of germanium and varieties of functions.

The junction transistor has no point contacts, which in the original transistor corresponded to the terminals of a vacuum tube. Instead, it consists of a tiny rod-shaped piece of germanium, treated so that it embodies a thin electrically positive layer sandwiched between the two electrically negative ends.

The junction transistor derives its name from the two "junctions" between the negative ends and the positive layer. It differs markedly from the point contact type in which the contacts at the points play an essential role.

Power consumption of this new type of transistor is remarkably low. The signal level often found in modern electronic equipment is about one millionth of a watt. But a full watt is ordinarily used to amplify this signal by conventional vacuum tubes. This is about like sending a 12-car freight train, locomotive and all, to carry a pound of butter. The new transistor, unlike any earlier amplifier, can be operated on about a millionth of a watt, which is just sufficient to carry the signal without waste.

Meanwhile, rapid strides are being made in readying the original point contact transistor, with its recent refinements and improvements, for actual commercial use in the Bell System. The transistor will be used in equipment manufactured by the Western Electric Company for the nationwide long distance dialing program.

Transistors, when the invention was first announced, were demonstrated as amplifiers for telephone and television circuits, and to provide the functions of detection

M. Sparks examines a section of germanium to locate a layer having the desired structure and type of conductivity.

R. L. Wallace (left) balances an AC bridge to measure the impedance of a transistor as W. J. Pietenpol records readings.

and amplification such as are found in an ordinary radio set. A short while later, Bell scientists invented a type which served as a photoelectric device. These and many other applications have been under continued study at the Laboratories.

Cooperating with Dr. Shockley in the original research were the inventors of the point contact transistor, John Bardeen and Walter Brattain. Dr. Shockley, who initiated and directed this general research program, is now in charge of the Laboratories' investigations in the broad field of transistor physics, and is the author of a recently published book "Electrons and Holes in Semiconductors."

Perhaps the most remarkable feature of these transistors is their ability to operate with exceedingly small power consumption. The best example of this to date is an audio oscillator which requires for a power supply only 6 microamperes at 0.1 volt. This represents 0.6 microwatt of power which contrasts sharply with the million or more microwatts required to heat the cathode of an ordinary receiving-type tube.

The power handling capacity, and particularly the efficiency, on the other hand, are high. The design can readily be varied to permit the required amount of power dissipation up to at least two watts. Furthermore, the static characteristics are so nearly ideal that Class A efficiencies of 48 or 49 out of a possible 50 per cent can be realized. The efficiencies for Class B and Class C operation are correspondingly high, reaching as much as 98 per cent.

Not only is the transistor a highly efficient unit, but it is compact and rugged. The transistor is enclosed in a hard plastic bead about 3/16 inch in diameter. Inside the bead three electrical connections are fastened to the germanium and are brought out as "pigtails" through the bead. This gives a very sturdy unit which readily withstands severe shock tests. The input and output impedances are always positive, whether the transistor is connected grounded-emitter, grounded-base or grounded-collector. This permits a great deal of freedom in circuit design and makes it possible, by choosing the appropriate connection, to obtain a considerable variety of input and output impedances.

Vibration tests in the audio frequency range produce no measurable microphonic noise.

Other salient characteristics of the new junction-type transistor are its relatively low noise figure and its high gain. The noise figure is 1000 times less than that of its predecessor.

While studies indicate that collector capacitance limits the frequency response at full gain to a few kilocycles, it is possible by using a suitable impedance mismatch to maintain the frequency response flat to at least one megacycle while still obtaining a useful amount of gain.

At 1000 cps, most of the units measured so far have a noise figure between 10 and 20 db. Power gains of the order of 40 to 50 db per stage have been obtained.

These devices are still undergoing exploratory development. While more complete information on the properties which may be achieved will be available after further development, the results to date are encouraging.

Cleo F. Craig

Cleo F. Craig Elected President of A T & T

Cleo F. Craig was elected President of American Telephone and Telegraph Company at a meeting of the Board of Directors on July 2 to succeed Leroy A. Wilson who died on June 28. Mr. Craig had been a vice president of the company since 1940, and vice president in charge of finance since November, 1949.

Born in Rich Hill, a small Missouri town, Mr. Craig was the youngest of seven children. He got a head start on what was to be a brilliant scholastic career by skipping two grades in the local grammar school, due mostly to his mother's home tutoring. At high school he graduated at the age of sixteen at the top of his class, winning the honor of delivering the valedictory address.

At the University of Missouri, where he studied engineering, "Red" Craig, as he was called on the campus, managed to maintain his excellent record in his studies, play forward on the varsity basketball team, and hold a job in the local book store. Although he was recognized on the basketball team as an excellent "set shot," he was best known as a team player, a characteristic which later proved to be a strong point in his business career.

In the classroom, he was particularly strong in his technical courses, and was occasionally called upon to assist his mechanics professor. When he was graduated in 1913 with the degree of Bachelor of Science in Electrical Engineering, he was a member of Tau Beta Pi, the engineering equivalent of Phi Beta Kappa; the Mystical Seven, the honorary senior society at Missouri, and Eta Kappa Nu, professional electrical society.

Shortly after his graduation, a telephone call helped solve the problem of choosing between two jobs—one with A T & T at St. Louis, the other with a Utah concern. St. Louis was nearer his home and the home of Laura Heck, the home town girl who soon afterward became Mrs. Craig. So the young engineer said "yes" over the telephone to A T & T and thus set the course of his whole business life.

Mr. Craig has spent his entire telephone career with A T & T. Starting as a $15-a-week equipment man in the St. Louis office of the Long Lines Department in 1913, he transferred a few months later to Kansas City as a division line inspector. He returned to St. Louis in 1917, was made acting district plant chief in 1918, and district plant chief the following year.

In 1922 Mr. Craig was transferred to New York as Long Lines plant accountant and later became construction supervisor. He went to Atlanta as division plant superintendent of the Southern division of Long Lines in 1925. He returned to New York in 1927 as special representative of the General Department of A T & T handling contracts with power and light, railroad, traction, oil and telegraph companies.

He returned to Long Lines as general manager in 1933, and seven years later was elected vice president in charge of the department.

Mr. Craig was elected vice president in charge of A T & T's Personnel Relations Department in 1941, serving in that capacity until 1948, when he was named to head the Operation and Engineering Department and the revenue requirements division. A year later, he was elected vice president in charge of finance and revenue requirements.

Possessed of a quiet, modest personality, Mr. Craig is remembered by the men who worked with him during his long service with Long Lines as "a friendly fellow with a fabulous capacity for work and a wonderful memory." George Quermann, retired Long Liner who was Mr. Craig's supervisor for a time at St. Louis, recalls that his "district man" "got up earlier, drove farther and still managed to look fresher than anyone in the district."

Mr. Craig is a director of the A T & T and of several of the Bell System associated companies, and a member of the Long Lines Board. He is also a director of the Chase National Bank, New York, of the Citizens First National Bank & Trust Company, Ridgewood, N. J., and a trustee of the Central Savings Bank, New York. He is also a member of the National Safety Council and a member of the corporation of the Presbyterian Hospital.

Mr. Craig is a Fellow of the American Institute of Electrical Engineers. He is a member of the University Club and Links Club of New York.

The Craigs live in Ridgewood, New Jersey. Mr. Craig's hobbies are golf, fishing and bridge.

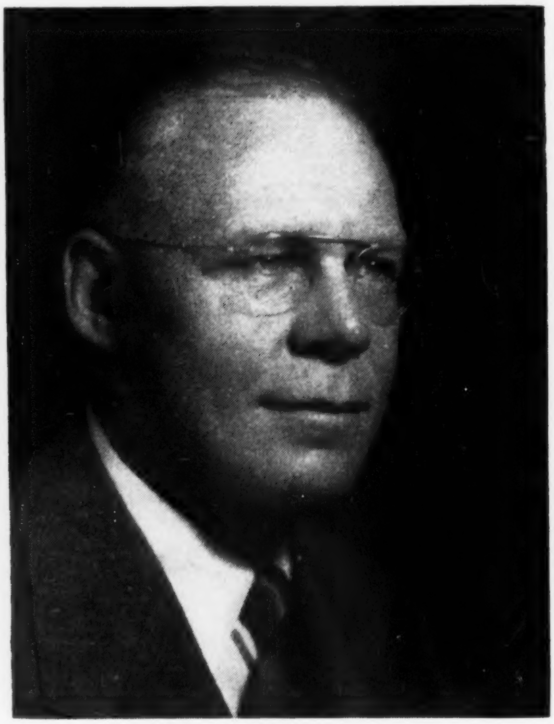
Bell System Organization Changes

Hal S. Dumas, Charles E. Wampler and T. Brooke Price have been elected vice presidents of the American Telephone and Telegraph Company. At the same time, new responsibilities were assigned to vice presidents Clifton W. Phalen and William C. Bolenius.

Mr. Dumas, who since 1943 has been president of Southern Bell, was elected executive vice president and a member of the Board of Directors of A T & T. He will assist President Cleo F. Craig in the general operation of the business.

Mr. Wampler, an assistant vice president in the American Company's operation and engineering department, was elected vice president in charge of revenue requirements studies.

H. S. Dumas



W. C. Bolenius

Mr. Price, general attorney of A T & T for the past ten years, was elected vice president and general counsel. He succeeds John H. Ray, who will retire on September 30.

William C. Bolenius, formerly vice president in charge of personnel relations, is now vice president in charge of accounts and finance. Clifton W. Phalen, formerly vice president in charge of revenue requirements studies, takes over the post of vice president in charge of personnel relations.

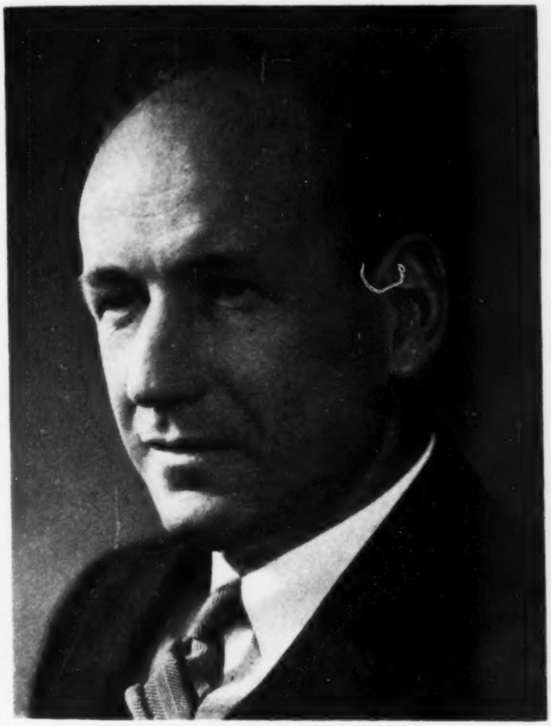
A graduate of Alabama Polytechnic Institute, Mr. Dumas joined Southern Bell in Atlanta as a traffic student in 1911. After holding a series of supervisory positions in the traffic department, he became assistant to the operating vice president in 1934. A year later, he was appointed assistant to the president and in 1936 became general plant manager. In 1938 he was advanced to the position of vice president in charge of operations, the post he held until he was elected president of the Southern Company.

Active in Pioneer affairs, Mr. Dumas was recently elected president of the national organization. He has also taken part in numerous civic activities and has served with the Red Cross, Community Chest, Boy Scouts and Chamber of Commerce and Rotary groups, and is president of the Capital City Club of Atlanta.

Mr. Bolenius started with the New York Company as a traffic inspector in New York City. He rose to the position of assistant vice president of that company in 1938 and became vice president and general manager of the upstate area five years later. He moved to the Wisconsin Company as vice president and gen-

eral manager in 1946 and was elected president in October of that year. He came to A T & T as personnel vice president in 1948.

Mr. Phalen also started with the New York Company, joining the company as a lineman at Syracuse in 1928 after his graduation from Yale University. He became a plant chief in 1929 and after holding a series of supervisory positions in the upstate plant department, was named assistant vice president, personnel, in 1943. He was elected vice president, personnel, a year later and moved to the public relations department in a similar capacity in 1945. He came to the A T & T Company as vice president in charge of public relations in 1948 and was named to the revenue requirements post last November.



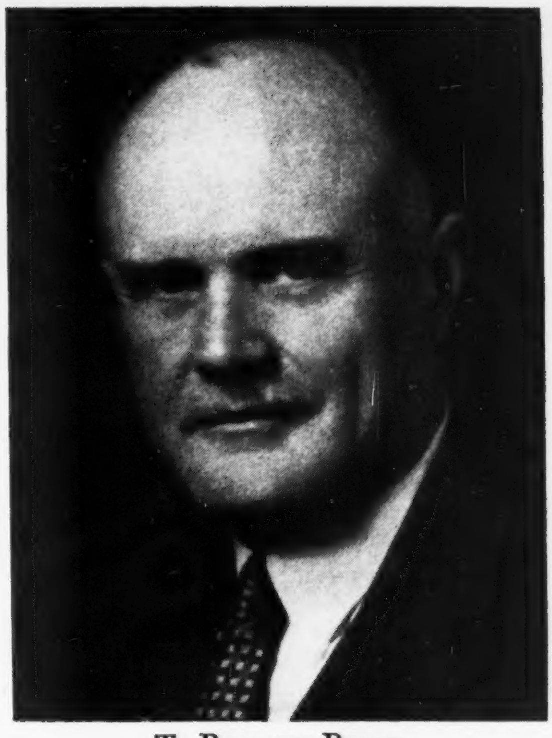
C. W. Phalen

Mr. Wampler's Bell System career started in 1929, shortly after his graduation from the University of Illinois. He served with the traffic department of Illinois Bell until 1939, when he was given a year's leave of absence to accept an Alfred P. Sloan Foundation fellowship at M.I.T.

Returning to the Illinois Company, Mr. Wampler continued in traffic and later engineering work until 1941, when he left to serve with the Office of Production Management and the War Production Board. In 1942, he joined the army, leaving in 1946 with the rank of lieutenant colonel in the Signal Corps.

C. E. Wampler

From 1946 until 1948, Mr. Wampler worked with the engineering and rate groups of Illinois Bell, and in the latter year he was named



T. Brooke Price

assistant vice president of the company. He came to A T & T in 1949 as assistant vice president in the personnel department and later that year was appointed general manager of Long Lines. He became assistant vice president in the operation and engineering department of A T & T in 1950. Earlier this year he served for a short period with the Defense Production Administration in Washington.

Mr. Price joined the legal staff of A T & T in 1934, after having represented the company in legal matters over a period of years. He was vice-president and general counsel of the Western Electric at the time of his appointment as general attorney of A T & T in 1941. He is a graduate of Johns Hopkins University and Harvard University Law School.

Edwin M. Clark has been elected president of the Southwestern Bell Telephone Company. He succeeds James L. Crump, who retired after 46 years of telephone service. John M. Black, formerly vice-president in charge of personnel at the Pacific Company, was named to succeed Mr. Clark.

A graduate of Virginia Military Institute, Mr. Clark began his telephone career in 1923 as a Western Electric installer in New York City, after working a short time as a high school teacher and football coach. In 1924, Mr. Clark transferred to the Bell Telephone Company of Pennsylvania as a student engineer.

E. M. Clark

F. J. Turner

After holding a series of supervisory positions in the plant department he became vice-president of personnel in 1942 and operating vice-president in 1949. He moved to the Southwestern Company in the same capacity a year later.

Fred J. Turner has been elected President of Southern Bell Telephone and Telegraph Company succeeding Mr. Dumas.

A native of Atlanta, Mr. Turner started with the telephone company as a clerk in the mailing department in the Atlanta general offices in 1907. By his twentieth birthday he was a bookkeeper in the revenue accounting department. In 1922 he was appointed manager in the Atlanta district office. Three years later he was transferred to Miami as office manager in the commercial department. As commercial supervisor he moved to Charlotte, N. C., in April, 1926, and later that year was transferred to Atlanta with the same title. Later he returned to Charlotte as Carolinas Division Manager. In 1937 he returned to Atlanta to direct commercial activities for the Company's entire nine-state area. From this position he was elected vice-president in charge of public relations in 1943, was elected to the Company's board of directors in 1944 and later that year assumed direction of the financial affairs in addition to his public relations duties.

Michigan Bell Directors Visit Laboratories

On June 22, the Board of Directors of the Michigan Bell Telephone Company paid an all-day visit to the Laboratories. Arriving on *The Detroiter*, the directors went first to Murray Hill. M. J. Kelly welcomed the visitors and spoke on the work of the Laboratories. W. H. Martin discussed *The 500-Type Set and Recent Instrument Development;* J. W. McRae, *New Transmission Systems and Military Carrier-Bell System Developments Applied to Military Service;* and Ralph Bown, *The Transistor.*

During the luncheon period R. K. Honaman spoke on the program which was planned for the directors at Murray Hill and West Street. Immediately after the luncheon they toured Murray Hill, visiting laboratories where E. I. Green spoke on *The Frequency Standard,* and on *Digital Computers,* R. J. Nossaman on *Outside Plant,* J. B. Fisk on *Instrumentation, Electron Microscope and Mass Spectrograph* and J. R. Townsend on *Materials.* The directors visited the exhibits on the Concourse before returning to New York to see West Street laboratories.

Four laboratories were included in their New York trip. J. Meszar talked on *Automatic Message Accounting;* F. J. Singer on *No. 4 Toll Crossbar;* A. J. Busch on *No. 5 Crossbar;* and A. C. Keller on *Relay Development.*

The group included Ben R. Marsh, Chairman of the Board; John S. Coleman, President, Burroughs Adding Machine Company; Leland I. Doan, President, Dow Chemical Company; Dr. John A. Hannah, President, Michigan State College; John A. Greene, President of Michigan Bell; William M. Day, Vice President and General Manager, Michigan Bell; Bartlett T. Miller, Vice President, A T & T; and L. M. Chicoine, Gerald G. Watt, A. B. Chapman, Jr., W. C. Patterson, H. F. Lange, R. E. Driver, and J. M. Smith of Michigan Bell.

R. J. Nossaman describes the work of the Outside Plant Development Department to Michigan Bell Directors.

American Red Cross Water Safety

Three volunteer American Red Cross water safety instructors, all members of the Laboratories, were honored at the annual dinner of the Somerville-Raritan Chapter of the American Red Cross. The instructors, Thelma Gradwell, George Ruble and Joseph Pauer, conducted swimming classes every Friday night from October through May for 162 school children of the Somerville-Raritan area, at the Plainfield High School pool.

The 1951 Annual Report of the Somerville-Raritan Chapter of the American Red Cross quotes in part:

"We would like to take this opportunity to thank the three volunteer water safety instructors: Miss Thelma Gradwell, Mr. George Ruble and Mr. Joseph Pauer, all from Morristown, who for the past two years have contributed so much of their time, enthusiasm and talents to make this program a success. Through their interest and unselfishness the children living in our Chapter territory have had an opportunity to learn swimming skills. We are deeply grateful to these people."

Stamp Club News Notes

The hospitalized veterans at Kingsbridge Hospital have their own Stamp Club. Unlike the members of the Laboratories Stamp Club the boys cannot visit other Clubs. One evening recently a group from the Laboratories Club visited the Veterans Club and R. Haard exhibited his collection of Swiss Pro Juventutes.

Each Thursday evening throughout the year, the Veterans are entertained by one of the eleven member clubs of the Associated Business Stamp Clubs under the direction of W. S. R. Smith of the Laboratories.

While a meeting is in session for those who can attend, tours are made through the sections and wards, to those who cannot leave their beds or rooms. Albums, stamps and other philatelic accessories are distributed to veterans interested in this hobby.

At present a program has been adopted to provide each of the 50 veteran members with a loose leaf binder album, and specially prepared pages* for the commemorative stamps issued by the United States during 1949 and 1950. They are encouraged to find these commemoratives in the packets distributed to them and to place each on its proper page. As a veteran completes his album, additional pages are provided for the 1948 issues. In this way considerable interest has been created and Thursday evening visits by the Stamp Club are looked forward to with eagerness by the veterans.

Material for this work is provided by voluntary contribution of stamps and philatelic accessories. The program is sanctioned by *Stamps for the Wounded* and by the Veterans Administration.

* Pages designed and published by W. S. R. Smith.

A. I. E. E. Summer General Meeting Held at Toronto

Several Laboratories' engineers presented papers at the Summer General Meeting of the A.I.E.E. held in the Royal York Hotel in Toronto, June 25 to 29. At the Electronic Instrument Session, T. Slonczewski gave a paper on *A Servo System for Heterodyne Oscillators.* J. B. Fisk spoke on *The Transistor—A Case History in Research and Development* at the Electronics Research meeting. *An Improved Telephone Set* was the subject of a conference paper by A. H. Inglis and W. L. Tuffnell, presented at the Wire Communications Session. At the session on *A Broad-Band Transcontinental Radio Relay System,* all three papers were by Laboratories authors. T. J. Grieser and A. C. Peterson presented their paper *Transcontinental Radio Relay System;* R. W. Friis and K. D. Smith, *Unattended Radio Relay Repeater,* and J. G. Chaffee and J. B. Maggio, *FM Broad Band Radio Relay Terminal.* At the Metallic Rectifier Session, D. E. Trucksess gave his

C. D. Hanscom explains a new Laboratories' lecture aid featuring the phototransistor during a conference for New York Telephone Company lecturers held at Glens Falls, June 21 and 22. With him are left to right M. S. Paige, Vice President Kennerly Woody and L. Query of the New York Telephone Company; M. E. Strieby of Long Lines; F. B. Morey and C. W. Snyder of the New York Telephone Company. Laboratories representatives at the Conference were A. R. Thompson and Mr. Hanscom, who discussed the Laboratories' lecture aid development program with the conferees.

paper *Metallic Rectifiers in Telephone Power Plants.*

Committee meetings occupied the attention of Laboratories' people also. D. E. Trucksess attended meetings of the committees on Electronic Power Converters, Metallic Rectifiers, and Electronics. The Wire Communication Committee meeting was attended by L. G. Abraham, Chairman, and H. A. Affel; Mr. Abraham was also present at the Communication Division Advisory Committee meeting. E. I. Green, Chairman, called a meeting of the Science and Electronics Division Advisory Committee, at which J. D. Tebo was present. Mr. Green and Mr. Tebo also attended the Technical Advisory Committee meeting and Mr. Tebo the Sections Delegates Conference. The Publications committee meeting was attended by R. K. Honaman, who also attended the Basic Science Committee meeting. At the Forum of Technical Committee Chairmen, the following were present: L. G. Abraham, E. I. Green, R. K. Honaman, M. B. Long, J. D. Tebo and D. E. Trucksess.

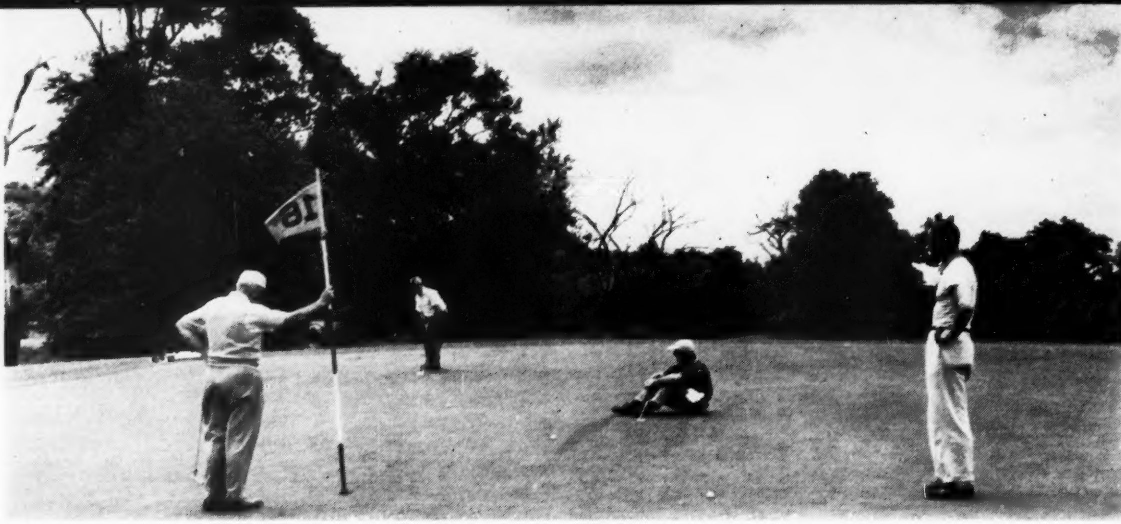
A very enjoyable social event for the Bell System people attending the General Meeting was a dinner at the Royal Canadian Yacht Club on Wednesday evening June 27, as guests of H. G. Young, General Manager, Western Area of the Bell Telephone Company of Canada.

News of Pioneer Women

Late in June the Women's Activity Committee of the Pioneers sponsored a twilight trip around Manhattan on the Circle Line Sightseeing Yacht. The three-hour guided trip gave a glimpse and short history of famous sights as the boat cruised around the island. During the summer the only group activity will be the knitting, crocheting or weaving of squares for laprobes for veterans of Korea now convalescing at St. Albans Naval Hospital.

Installation of Legion Officers

The 32nd annual installation of the Bell Telephone Post No. 497 was held Friday, June 15, at the Hotel Lexington. New York County Commander William T. Collins II installed the following officers: Left to right, below, J. J. Morrow, Commander; E. J. McCormack, first Vice-Commander; R. A. Loos, second Vice-Commander; J. W. Lea, third Vice-Commander; C. E. Merkel, Adjutant of the Laboratories; Florence Lutgen, assistant Adjutant of the Laboratories; H. C. Richards, Finance officer; E. N. Emmons, Service officer; D. D. Sakolos, Chaplain; and H. J. King, Sergeant-at-Arms. Other members of the Laboratories holding office are L. E. Gaige and G. J. McArdle, Executive Committee and W. A. Bollinger, County Delegate. Left to right, A. W. Draper, outgoing commander of Bell Telephone Post No. 497, and J. J. Morrow, incoming commander.



A. E. Hague, E. F. Ennis, O. Cesareo and H. M. Yates.

B. W. Kendall, J. F. Hanley, C. W. Christ and son Peter.

New Jersey Golf Tournament

The spring golf tournament of Bell Laboratories Club was held at the Essex County Country Club on June 16. Low net prize winners in Class "A" were G. H. Baker, first; J. F. Hanley, second; A. H. Bobeck and C. W. Christ, tied for third; and H. M. Yates, fifth. Kickers' prizes went to E. F. Ennis and L. S. Cooper. In Class "B" low nets were H. G. Petzinger, first; W. L. Whinn, second; R. D. Fracassi and R. L. Shepherd, tied for third; and C. R. Gray and E. L. Fisher, tied for fifth. Kickers' prizes in this Class went to J. Kocan and H. T. Reeve.

T. C. Rice, R. V. Rice, W. F. Malone and L. S. Cooper.

W. J. Fullerton and M. P. Hughes.

J. M. Niedzwiecki

W. L. Brune, A. H. Bobeck, C. E. Luffman and C. W. Thulin.


J. H. McCaughey


B. G. Hemmendinger


T. J. O'Connor


W. J. Jensen

Called to Active Duty

During June four military leaves of absence were granted, bringing the total to forty-four since June, 1950.

Bernhard G. Hemmendinger has been a member of the Laboratories since 1946. During World War II he served as a Naval lieutenant in advance base mine depots where he was engaged in influence mining. After joining the Laboratories he took the Telephone Switching Design course and then spent two years on fundamental relay studies. Subsequently he took up development work in AMA and step-by-step automatic ticketing. More recently he has contributed to the development of new automatic testing facilities for No. 5 crossbar offices. Lieutenant Hemmendinger has been called into active service and is now on duty in North Africa.

James H. McCaughey has enlisted in the Air Force and is now at the Sampson Air Force Base, Sampson, N. Y. Mr. McCaughey was a member of the Photocopy Department. Before entering the service he had been a member of the Glen Rock Volunteer Ambulance Corps.

Thomas J. O'Connor, a Naval reservist, has been recalled as a radar technician. Mr. O'Connor has done drafting design and development work for various branches of the military service. Prior to being assigned to Whippany in 1946 he was a member of the drafting group of the Commercial Products Development Department at Varick Street.

Wilbur J. Jensen, in orders recalling him to active military service, has been assigned to the Signal Corps School at Fort Monmouth. Mr. Jensen joined the Laboratories on January 22, 1951. A veteran of six years military service during World War II, he studied at Temple University Technical School, and at Rutgers University. He was an instructor for the Reserve Officers Training Corps in communications work before going to Murray Hill to work.

A.S.T.M. Convention At Atlantic City

The active cooperation which has long gone on between the Laboratories and the A.S.T.M. was again emphasized when fourteen Laboratory members attended the latter's convention at Atlantic City. J. R. Townsend presided at meetings on non-ferrous metals, die casting and methods of test and K. G. Compton, at one on the corrosion of non-ferrous metals and alloys. *The Plasticity of Lead* was the subject of a paper by G. M. Bouton and G. S. Phipps. E. K. Jaycox headed a committee on spectographic analyses of copper and nickel alloys and A. Mendizza, another on hardware testing. G. R. Gohn presented a paper entitled *The Fatigue Test as Applied to Lead Cable Sheath* which W. C. Ellis co-authored. Mr. Gohn enters his third year as a member on the Administrative Committee on Papers and Publications. F. J. Biondi presided at a technical session on fine wire. W. C. Ellis presented a paper, written with J. D. Cummings, on *Creep Test Methods for Determining Cracking Sensitivity of Polyethylene Polymers.* F. Hardy attended meetings of Committee D2 on Lubricants. While in Atlantic City, he also attended a meeting of the Coordinating Research Council, where the lubrication of electronic equipment was discussed. Also present at the convention were H. Peters, H. A. Birdsall, K. G. Coutlee, V. T. Wallder and C. L. Luke.

RETIREMENTS

Recent retirements from the Laboratories include S. J. Guss with 43 years of service; H. E. Marting, 42 years, and G. M. Classen, 31 years.

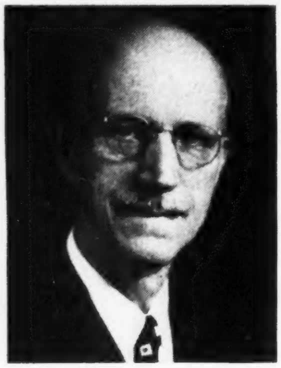
Stephan J. Guss

Western Electric was still doing manufacturing at West Street when Steve Guss came to work here in 1907. Claiming no particular skills, he was taught to run a screw machine, and as the chances came was allowed to try his hand on the other machine tools. Then transferring to building maintenance he worked up to be a foreman.

When the panel dial program was getting under way, Mr. Guss became a laboratory mechanic and helped to set up the switching frames, first in 7B and later, when Section K was acquired, in that area. As time went on he made small parts and assembled equipment for most of our dial systems. His last big project was a series of tape readers for A.M.A.

Mr. and Mrs. Guss expect to remain in their home in Teaneck. They have a son—a Captain in the Quartermaster Corps and a daughter, both married, and four grandchildren.

H. E. Marting



S. J. Guss

G. M. Classen

Heber E. Marting

When he graduated from Ohio State (M.E. 1909) Heber Marting entered Western Electric's Hawthorne organization. Four years later he was "loaned" to West Street to engineer the power plants for the three Newark central offices which pioneered the panel dial system. Continuing here, he had charge for some years of power plant development for panel systems and later worked on equipment development on all the major types of switching systems. Establishment of the 12 ft. 6 in. standard ceiling height for central offices was one outcome of his early standardization work. Another of his projects, worked out with Western Electric engineers, was the fabrication of cable racks on the job, avoiding the extensive engineering required for shop fabrication. For many years Mr. Marting has been in charge of a group who formulate and revise Bell System standards for central office equipment. These standards greatly facilitated manufacture and installation, and expedited heavy programs, first for panel, then step-by-step, and still later crossbar.

Mr. Marting's retirement takes from the Laboratories the last of the celebrated "Class of 1909"—a group who have preserved their identity ever since joining Western Electric's student course in that year. Gardening and his large collection of recorded music are his personal hobbies.

G. M. Classen

Gene Classen and his wife are back in Puerto Rico now, after 34 years in the States. During World War I he joined us as a stockroom worker. When the night shift was dropped after the war, he became a porter, then worked elsewhere for a couple of years. In 1922 he became a stockkeeper again, and for a time had charge of a stock of public address systems used for special installations. When this was taken over by ERPI he became in 1927 an inspector in the Receiving Department. Over the years he has been responsible for checking received material against the orders, seeing that it is undamaged in transportation and routing it to the person who ordered it.

Since Mr. and Mrs. Classen were born in Puerto Rico, and have kin there, they are looking forward to happy days in a home they have just built in Isla Verde, a suburb of San Juan. However, they must leave behind them their three children and six grandchildren, but then there are ships and airplanes to bring them back once in a while.

Laboratories Women Elected to Society of Women Engineers

Mary Kitchell Stokes has been elected President of the Metropolitan New York Section of the Society of Women Engineers, a national organization. She is one of a group of women engineers from the Laboratories who are active in the Society. At the election of officers, Stella Lawrence became chairman of the Research committee and Matilda Goertz chairman of the Constitution and By-Laws committee, Margaret Packer and Jean Lubking Bertels are also active in the society.

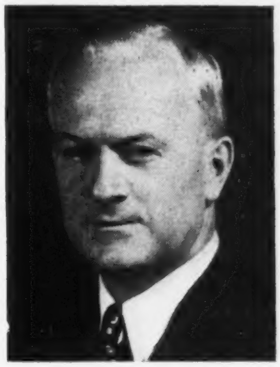
Mrs. Stokes is a member of the Switching Systems Development Department where she is engaged in standardization work on switching circuits.

The Society of Women Engineers aims to foster congenial relationships between women engineers and industry, to encourage women who show an aptitude for and a desire to study engineering, and to encourage membership in the Engineering Societies and adherence to their codes of ethics.

H. G. W. Brown
45 Years

P. A. Jeanne
35 Years

S. I. Cory
35 Years



O. H. Loynes
35 Years

August Service Anniversaries of Members of the Laboratories

45 Years

H. G. W. Brown

35 Years

L. S. Armstrong
S. I. Cory
Helen Hoar
J. M. Hudack
P. A. Jeanne
O. H. Loynes
S. Terry
O. J. Zobel

30 Years

C. N. Anderson
W. E. Doremus
G. H. Donwes
B. F. Lewis
C. O. Parks
A. Scaglione
W. E. Stephens
E. R. Taylor

25 Years

Marjorie Amrhein
F. B. Anderson
D. S. Bender
B. H. Carmer, Jr.
F. L. Crutchfield
J. E. Fox
S. Heid
E. S. Pennell
B. Simpson
Margaret Spindler
C. B. Swenson

20 Years

S. Cunningham
F. R. Dickinson
F. G. Foster
H. Kelly
W. M. Knott
G. E. Stowe
D. J. Wernert

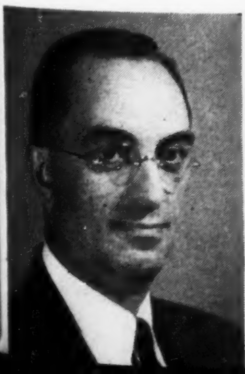
15 Years

Mary Andrejcak
J. R. Davey
H. W. Evans
R. F. Graham
E. A. Hake
M. E. V. Johnson
R. F. Lane
A. W. Lebert
J. C. Lozier
J. J. Madden
W. A. McFadden
J. A. Morton
T. A. Pariseau
J. P. Pasternak
H. G. Petzinger
F. C. Roeckl
E. F. Scheer
C. W. Spencer
H. A. Stone, Jr.
W. W. Tuthill
H. Wilms

10 Years

H. J. Braun
W. F. Brown
Eileen Clifford
J. W. Cook
M. T. Hearn
P. J. Keely
R. J. Ledingham
E. S. Lynn
R. D. Nostrand
Frances Novick
R. C. Pomeroy
D. G. Sandford
A. J. Sandor
P. H. Shearer
C. A. Sjursen
J. I. Stockwell, Jr.
Viola Watson

O. J. Zobel
35 Years



L. S. Armstrong
35 Years

S. Terry
35 Years

J. M. Hudack
35 Years

PIONEER PICNIC AT FARCHER'S GROVE

Frank B. Jewett Chapter, Telephone Pioneers of America, rounded out an active and interesting year with the Chapter Picnic on June 9 at Farcher's Grove, Union, N. J. The 1115 members and guests found games, sports, refreshments, and entertainment to the liking of each.

As usual, the children wore out four ponies and kept the "Whip" overtime in addition to a full program of contests, while the adults watched or engaged in modern and square dancing. For the athletes there were horseshoes, golf-chipping, baseball and volley-ball. The day's festivities ended with "Dunc" Peckham's impromptu minstrel show and drawing for the door prizes.

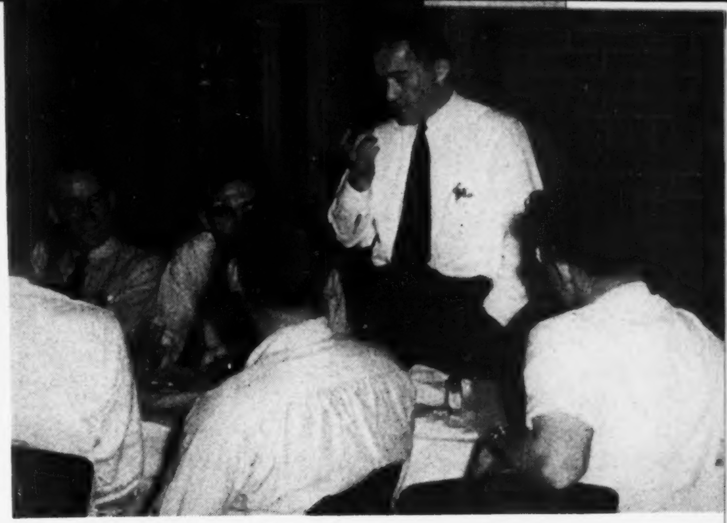
Deal-Holmdel Colloquium Annual Spring Party

Nearly fifty members of the Laboratories gathered at the Willowbrook Restaurant in Fair Haven, New Jersey, at the annual spring party of the Deal-Holmdel groups. This event, which is held annually at the close of the Deal-Holmdel Colloquium season, was the occasion for considerable singing under the direction of Luke Lowry. Art Crawford, able as usual, accompanied.

Under the toastmastership of Al Beck, a spontaneous outburst of story telling developed, with contributions from many of the visitors from Murray Hill and New York.

The "formal program" included a group of numbers by a Ukulele ensemble made up of Bill Jakes, Bill Legg, and Ray Desmond. The number, *Makin' Love Ukulele Style* was embellished by the appearance of a grass-skirted Hula dancer portrayed by Bill Goodall.

Lampooning the inability of technical men to refrain from technical talks even at stag dinners, a pseudo-technical memorandum was read by Archie King.



W. H. Doherty takes part in the story-telling.

Murray Hill Popular Orchestra Presents Fifth Show

At noon on June 20, the Murray Hill Popular Orchestra, under the direction of Larry Speck, gave its fifth semi-annual performance before 800 members of the Murray Hill Laboratories. The show opened with the theme of the Murray Hill Popular Orchestra, an original melody by Harry Geetlein, followed by *Smoke Rings*. This particular number featured Mr. Speck, taking the trombone solo and also Chick Wallschleger doing the clarinet solo.

Next, *String of Pearls* featured the "pearls" of the Murray Hill group with ad lib solos taken by Bert Kossman, alto saxophone; Hank LeCour, tenor saxophone; Tony Presti, trumpet; and Mr. Geetlein, piano. This selection was followed by the orchestra playing *Petite Waltz,* featuring Mr. Geetlein.

Always searching for new talent among the Laboratories personnel, the orchestra next presented Rosalie Girgenti, recently employed, singing *Would I Love You.*

John Karlin, who has been heard often doing classical violin solos, was assisted by the orchestra in swinging *The Hot Canary* on the fiddle. Since no orchestra arrangement was available for this number, the score for the entire number was done by Uno Matson.

In making their third appearance, the "band-within-a-band," the Dixieland Combo, entertained with the number *At the Jazzband Ball,* a real Dixieland swingeroo.

The program ended on a special Glenn Miller arrangement of *When Day Is Done,* followed by the final *American Patrol,* another Miller arrangement.

The Murray Hill Popular Orchestra, left to right, John Potter, tenor saxophone; Bert Kossman, alto saxophone; Harry Geetlein, piano; Chick Wallschleger, alto saxophone; Ray Chegwidden, baritone saxophone; Hank LeCour, tenor saxophone, John Karlin, featured violin soloist; Rosalie Girgenti, featured vocalist. Frank Dempsey, drums; Larry Speck, director and trombone; Harold Hopper, guitar; Ray Biazzo, bass; Uno Matson, trombone; John DeFeo, trumpet; Tony Presti, trumpet; John Barstow, trombone; Ed McDermott, trumpet; Frank Crutchfield, trombone; and Bill Ward, trumpet.

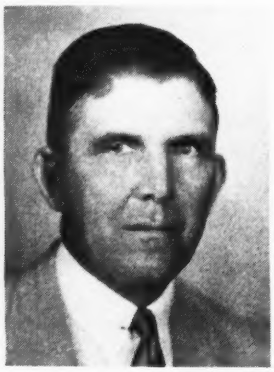
RECENT DEATHS

GOODWIN ROSENBLUM
December 5, 1869–June 23, 1951

In 1898 a young man by the name of Goodwin Rosenblum came to work in the tin shop at West Street. He was dubbed "John" by an associate who had difficulty in pronouncing his first name, and John he remained for thirty-two years in the sheet metal shop. During those years the youthful telephone industry was expanding rapidly and numerous new developments came into being. When the transcontinental circuit was projected engineers told John what they wanted and he furnished it. When horns for the early public address system were required, they were constructed under his supervision. He also contributed to the building of apparatus for transatlantic telephony by means of radio and to the development of sheet-metal work required in early television, ship-to-shore telephony and to the powerful apparatus for the first South American circuits.

When he retired in 1930, John used a cane. He was hospitalized for many years before his death.


GOODWIN ROSENBLUM


FRANK HEBER GRAHAM


C. W. CARSON


C. E. LANE

FRANK HEBER GRAHAM
October 30, 1882–July 11, 1951

Mr. Graham, formerly of the Equipment Development Department, was retired in January 1945, after thirty-six years of service. His Bell System service began at Hawthorne in 1908 following his graduation from the University of Kentucky with a B.M.E. degree. A year later the Western Electric Company discontinued the manufacture of power machinery. He then moved to the telephone division, where, after two and a half years in the manufacturing, installation and merchandise groups, he joined the engineering organization. In 1917 he came to New York with several others to study the equipment phases of the panel dial system then being introduced into the metropolitan area and during this time he developed the equipment arrangements for key and call indicators. He had since been engaged in the design of central-office equipment for the panel and crossbar dial systems and for other systems, both in use and proposed. During World War II he had been concerned with the design of sheet metal casings and cabinets for housing equipment used by the Armed Forces. Mr. Graham contributed many ideas and inventions for telephone systems and some especially important ones in connection with dial cut-overs such as the junctor group cut-over arrangements described in the January, 1945, issue of the RECORD.

CHARLES W. CARSON
November 13, 1896–July 8, 1951

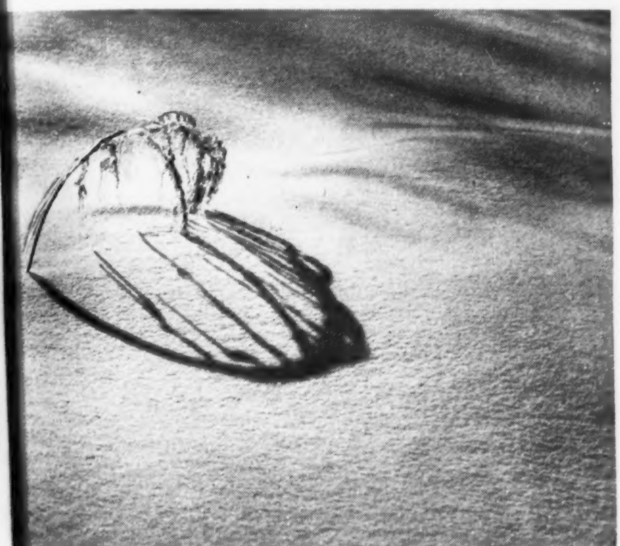
Mr. Carson's career in the Bell System was a varied one. A chief electrician's mate and navy instructor in World War I, he joined Western Electric at 195 Broadway when he was released from service. In January, 1922, Mr. Carson joined the New England Telephone Company in Boston where he was engaged in work on engineering traffic orders and cost studies for panel dial offices until 1928. For the next year he was at Hawthorne engaged in the engineering of panel dial central offices. From 1929 to 1949 he was again concerned with the installation of manual crossbar and toll offices and also with the testing of secret equipment for the Navy. Since coming to the Laboratories he had been associated with Bell System Practices for central offices.

CLARENCE E. LANE
November 23, 1892–June 23, 1951

Since retiring in 1948, Mr. Lane had been experimenting in horticulture in the greenhouse he built at his home in Terre Haute.

His career began in 1921 near the beginning of our intensive work in acoustics. He had previously received his A.B. and M.S. degrees from the University of Iowa. His first five years were occupied with studies of auditory masking of one tone by another; in the development of loud speakers; and on the artificial larynx. In 1926 Mr. Lane transferred to transmission networks and had charge of the development of crystal filters. Early in 1942 he was given charge of all filter work in Transmission Apparatus Development.

Among Mr. Lane's notable personal contributions to the art is the duplex low-frequency crystal, described in the Record in February, 1926. His mechanical model of the band-pass filter, using pendulums and springs, is in the Franklin Institute Museum in Philadelphia; it enables one to see the actual functioning of a



wave filter. Eleven patents and fifteen published papers in various technical publications record his original contributions to the communications art.

News Notes

The new card translator, which will play an important part in nationwide dialing, is now going into production. G. Puller recently went to Hartford to discuss with manufacturers the characteristic of a special perforator bearing used in processing the cards.

The quality of Bell System apparatus is under continual study by the Laboratories, and F. I. Smith and H. B. Brown recently went to Hawthorne to discuss with Western Electric engineers the results of a quality survey recently made on 206 and 209 type selectors.

Camera Club Prize Pictures

Above—First prize, Restricted, by W. C. Jurgens.

Left—First prize, Miscellaneous, by W. S. Suydam.

Below—First prize, children, by J. F. Neill

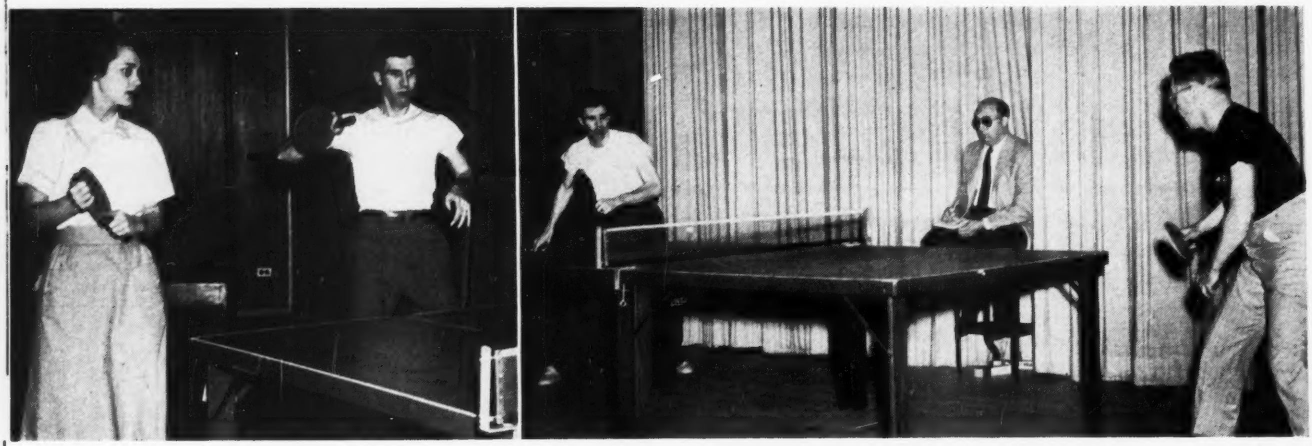


Table tennis championships at Murray Hill, left, the mixed doubles champions were Doris Campbell and J. V. Elliott. Right, J. V. Elliott (left) defeated W. F. Brown in three straight games to retain the men's singles title. R. F. Graham was the referee.

News Notes

P. C. JONES became Editor of the *Bell System Technical Journal* effective with the July issue. He became Associate Editor on the retirement of R. W. King in the fall of 1949, and has been Acting Editor since the retirement of J. O. Perrine in February of this year. In addition to his work on the *Journal,* he will continue as Science Editor of the RECORD.

SINCE THE WAR it has become increasingly the practice to extend the telephone plant into sparsely settled areas by means of small diameter light weight cables where open wire would formerly have been used. It has been found that under certain conditions of wind and topography such aerial cable lines are subject to wind induced oscillations (dancing) of low frequency and high amplitude, which can at times become so violent as to be destructive to the cable. In May, T. C. HENNEBERGER, with P. J. Buch of the American Company, visited Lubbock, Texas, and Clovis, New Mexico, to obtain first hand information on this problem and to arrange for a field trial of various proposed mitigative means.

R. H. COLLEY attended a conference at the Forest Products Laboratory, Madison, Wisconsin, on the results of cooperative investigations of laboratory methods for evaluating wood preservatives, and on the correlation of these results with test plot and service experience.

A FACE, KNOWN to many readers of the RECORD because it appeared twice on our covers, is now no more. Thomas Jones, who posed as Santa Claus on the Christmas cover of the RECORD for 1948 and 1950, died recently in his seventy-fourth year. He was an assistant secretary of the Flushing Y.M.C.A., and because of his love for children would dress up and play Santa Claus in the local hospital, the Red Cross and elsewhere.

L. H. CAMPBELL discussed treatment of poles with Chemonite—a clean salt-type wood preservative—with engineers of the Pacific Company at San Francisco. He also visited the treating plant at Alameda in connection with the discussions.

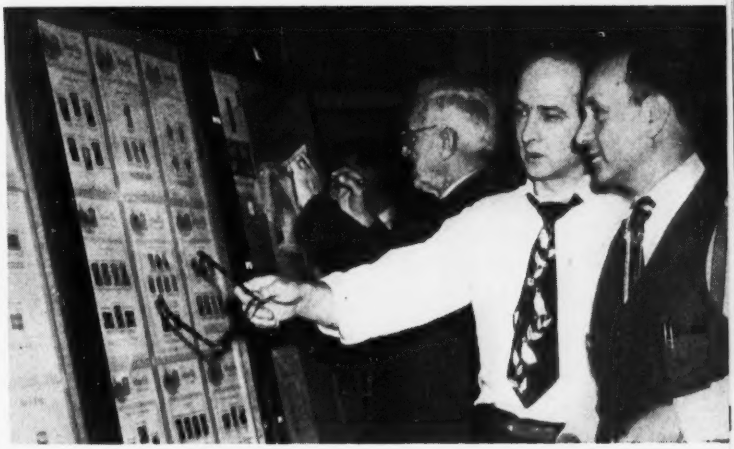
Stamp Club Exhibition

The twelfth exhibition of the Bell Laboratories Stamp Club was judged on May 16 by three prominent collectors from the Associated Businessmen's Stamp Clubs. At a supper gathering subsequent to the judging, first awards were presented to P. W. Blye, Mrs. Mattie Jones, E. A. Thurber and W. Kuhn; second awards to Parnel Bray, Mrs. Mattie Jones, W. Ehrig, R. Haard and C. J. Meden.

Members of the Laboratories visited the exhibit in the Lounge Area at West Street on May 17 and 18. By popular vote "the most interesting" exhibit awards went to Parnel Bray, first; Mrs. Mattie Jones, second and third; R. Haard, fourth; W. Kuhn, fifth; and P. W. Blye, sixth.

At the annual meeting of the West Street Stamp Club on June 4, officers were elected and installed for the 1951-1952 season. They are *Chairman,* R. Haard; *Vice Chairman,* M. A. Specht; *Secretary,* Parnel Bray; *Librarian,* E. R. Carter; *Exchange Manager,* C. J. Keyser; *New Issue Manager,* E. J. Mandable; and *Philatelic Purchasing Manager,* H. E. Ehrich.

Stamp Club luncheons will continue during the summer in the conference dining room at West Street every Monday at 12 o'clock.



T. Fisher, T. Musca and P. Mucci attentively check stamps which interest them.

Organization Changes

The following changes have been made in the organization of A. C. Keller, Director of Switching Apparatus Development.

C. A. Lovell has been appointed Assistant Director of Switching Apparatus Development, reporting to Mr. Keller. In this capacity Mr. Lovell will be responsible for planning, with particular reference to exploratory switching apparatus development and all experimental work conducted in Mr. Keller's department.

E. L. Norton has been appointed Switching Apparatus Engineer, reporting to Mr. Keller. In this capacity Mr. Norton will be responsible for exploratory work on switching apparatus.

W. E. Balph of Apparatus Drafting Department and R. A. Clarke of Switching Development Drafting Department have become Drafting Supervisors.

Friede Scherer has been transferred from the Apparatus Files to the Transmission Systems Files and promoted to Clerical Supervisor, replacing Mrs. J. G. Mulligan who is on leave.

H. Watkinson has been transferred from Specifications to Apparatus Drafting where he becomes Drafting Supervisor. H. G. Geetlein has been transferred from Apparatus Drafting to Specifications as a Technical Staff Associate. W. B. Sage has been promoted from Technical Assistant to Technical Staff Associate. Promotions from Engineering-Draftsmen (Mechanical) to Drafting Supervisors have come to A. A. Huebner, A. G. Kobylarz, A. H. Kuhlman, H. W. Sanford and W. Stanewicz.

News Notes

PERMANENT MAGNETS will be made smaller and so, less costly as ways are found to pump more magnetization into them. Among the factors which need to be better understood is the anistropic property which causes a magnetic material to be more magnetizable in one direction than another. With E. A. NESBITT as co-author, R. D. HEIDENREICH presented a paper on *Magnetic Anistropy and Physical Structure of Alnico V* at the American Physical Society meeting in Schenectady.

D. A. MCLEAN is to serve on the executive committee of The American Chemical Society's Lackawanna Subsection. Mr. McLean has also been appointed chairman of the Committee on Education, American Institute of Chemists, New Jersey Chapter.

R. M. BURNS joined members of the M.I.T. faculty and leading industrial authorities in presenting an intensive one-week course in *Corrosion* at Massachusetts Institute of Technology. Principal purpose of the week-long event was to bring new information about corrosion control within the reach of men in industry. Dr. Burns' subject was *Metallic and Organic Coatings: Selection Application and Behavior.*

Carpenter Moves to Sandia

On July 12, many members of the Laboratories gathered at an informal reception to wish good luck to their long-time associate Warren W. Carpenter. The following day Mr. and Mrs. Carpenter left by automobile for New Mexico, where at his request he has been assigned by the Laboratories to the staff of Sandia Corporation.

News Notes

JEAN WADE RINDLAUB, wife of WILLARD RINDLAUB of General Standards, was honored as the Advertising Woman of the Year by the Advertising Federation of America at its meeting in St. Louis during June. Mrs. Rindlaub is vice-president of Batten, Barton, Durstine & Osborn, Inc., a New York firm. The Rindlaubs, who live in West Englewood, have a son, John, a student at Hotchkiss, and a daughter, Anne, a student at Teaneck Junior High School. Both Mr. and Mrs. Rindlaub have shared in scouting, community chest, and P.T.A. work.

ROBERT BURNS, an authority on plastics and insulating materials, was one of ten leaders in the field of engineering materials honored by the American Society for Testing Materials at its annual meeting in Atlantic City when he received the Society's 1951 Award of Merit.

AT THE ANNUAL BOWLING DINNER of the Whippany Women's Bowling League held in Florham Park, N. J., the following girls were elected to office for the 1951-1952 year: Chairman, PATRICIA CALLAHAN; Secretary, FANNY NOBILE; and Treasurer, MARYANN KUFTA. Prizes were awarded for *High Average* 1st place to BETTY ENGSTROM and 2nd place to SIMONE BAXTER. *High Game* honors went to MARJORIE EDWARDS and *2nd High Series* to PATRICIA MUNTHER. In the Headpin Tournament *High Game* went to FANNY NOBILE with *High Average* to MARIE DEMPSEY and RITA ZOCH.

"The Telephone Hour"

NBC, Monday Nights, 9:00 p.m.

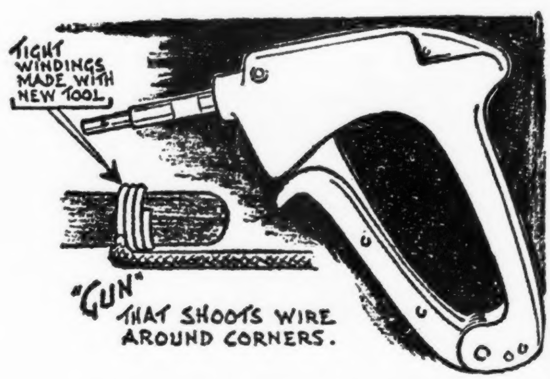
August 6	Ezio Pinza, *basso*
August 13	Eileen Farrell, *soprano*
August 20	Nelson Eddy*, *baritone*
August 27	Oscar Levant, *pianist*
September 3	Lily Pons, *coloratura-soprano*
September 10	Jussi Bjorling, *tenor*
September 17	Bidu Sayao, *soprano*
September 24	Jascha Heifetz, *violinist*

*From Carnegie Hall.

W. W. Carpenter receives a farewell gift from his associates, presented by C. E. Brooks.

F. E. DORLON has been elected president of the Industrial Cafeteria Managers' Association for a two-year term. At the fourth conference of the Association held in Peoria, Illinois, C. W. Gray of Kearny was elected vice-president of the Association. Mr. Dorlon also attended the National Restaurant convention in Chicago where he served as chairman of the panel on *Problems of Rationing, Shortages, and Price Ceilings* in the session for *Company Operated In-Plant Food Service Managers.* J. R. Coffield of Hawthorne participated in the panel.

JEAN PICK of the Voucher Accounting Department obligingly posed for the Laboratories advertisement on the back cover.



The cartoonist, R. J. Scott, picked the "wiring gun" from a recent Bell Laboratories advertisement and incorporated it in his "Scott's Scrap Book," distributed to newspapers by King Features Syndicate.

STRENGTH in time of disaster

HEARD ON THE TELEPHONE HOUR, JULY 16, 1951

Tonight flood waters still swirl relentlessly over the broad prairies and through the cities of Kansas, Oklahoma and Missouri.

Thousands of men and women are still working to protect their communities against the flood. Others are beginning to dig themselves out of the mud left by the receding water.

All America is lending its hearts and its hands to those thousands who have been rendered homeless in this great disaster. Each helps in his own way, and our way is to maintain and quickly restore the telephone lines that are so important in the whole job of relief and restoration.

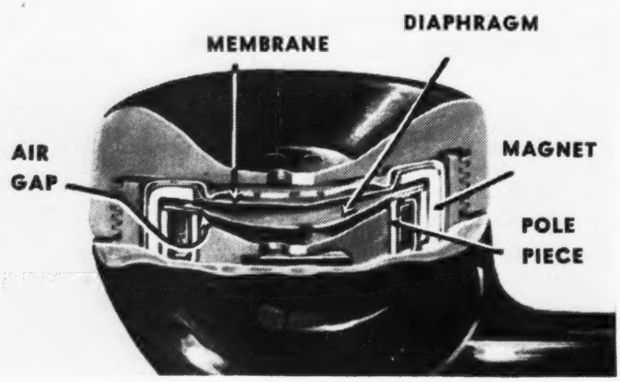
Since the middle of last week, telephone people have been fighting around the clock to protect vital telephone lines and to supply emergency service wherever needed. They've thrown dikes of sandbags around threatened telephone offices. They've raised switchboards above the rising water . . . brought in emergency power plants . . . rigged special toll lines and brought in mobile radio telephones to isolated towns, working ceaselessly to keep messages flowing.

From Texas, Oklahoma, Nebraska and Iowa, hundreds of trained telephone workers sped to the scene. Western Electric, manufacturing and supply unit of the Bell System, started the flow of materials to the Kansas City distributing center. By chartered plane, by fast freight and by truck—from Kearny, New Jersey, Portland, Maine, Boston, Baltimore, Chicago and Indianapolis—equipment began to move. Some of the amounts are staggering. 46 million conductor feet of exchange cable—a million and a half feet of drop wire—25,000 telephones.

Tonight, telephone people are still fighting the rising waters. Others are getting ready to move in to restore normal service as quickly as mud and water will allow.

The flood is another proof that only a financially strong telephone system can provide the telephone service the nation requires to meet sudden emergencies, whether those of nature or of man.

Easy on the ear



More naturally than ever, your voice comes to the ear that listens through the latest telephone receiver developed at Bell Telephone Laboratories. The reason: a new kind of diaphragm, a stiff but light plastic. Driven from its edge by a magnetic-metal ring, the diaphragm moves like a piston, producing sound over all of its area. Effective as are earlier diaphragms of magnetic-alloy sheet, the new one is better, gives more of the higher tones which add that personal touch to your voice.

To work the new receiver, telephone lines need deliver only one-third as much power. So finer wires can do the job. This is another new and important example of the way Bell scientists work to keep down the cost of telephone service, while the quality goes up.

BELL TELEPHONE LABORATORIES

WORKING CONTINUALLY TO KEEP YOUR TELEPHONE SERVICE ONE OF TODAY'S GREATEST VALUES